RELATIONSHIP BETWEEN RESEARCH AND TEACHING IN DOCTORAL EDUCATION IN UK UNIVERSITIES: THE CASES OF EDUCATION AND CHEMISTRY

KUANG-HSU CHIANG

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INSTITUTE OF EDUCATION
UNIVERSITY OF LONDON

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Abstract

This study aims to investigate the relationship between staff research and teaching in doctoral education with a special reference to disciplinary variations. There is substantial literature on this relationship in higher education, and there has been much debate about whether they are complementary or competitors for the resources of universities. There is however, little research at the level of doctoral education. This may be because it appears to be self evident that there is a posit.ve link at the doctoral level. However this is a hypothesis that needs testing.

In order to do this testing, a questionnaire composed of two major dimensions of doctoral education – Supervision and Research environment for doctoral students – was distributed to about 2,200 full-time doctoral students in Education and Chemistry in UK universities. The dimension of supervision was divided into three components – the supervisor's facilitation of learning, his or her accessibility and the relevance of the supervisor's research to that of the student. The dimension of research environment for doctoral students was categorised into four components – the academic culture of social interaction, the intercultural facilitation of research (for international students), the research training programmes and research facilities. The relationship between staff research (the 1996 RAE scores) and the effectiveness of doctoral education as perceived by students is analysed along the above dimensions. Follow-up interviews were also conducted with students.

On the whole, little relationship between departmental research performance (the RAE scores) and effectiveness of doctoral education is found in Education and Chemistry, especially pertaining to the aspects of supervision. However, the results of research environment are more complex. With regard to disciplinary differences, although the general findings of a lack of a significant relationship between research and teaching apply to both Education and Chemistry departments, it is interesting to note that doctoral education is more favourably perceived on most counts in supervision and research environment for doctoral students in Chemistry than in Education. Finally, a theoretical framework of research training structures to discuss these findings is offered.

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If you are a reader, I wish to thank you for giving me an opportunity to show you what the relationship between research and teaching in doctoral education can be when students' voices are heard. Thank you for allowing this discovery to take you to a place where knowing itself is no limits or rules and where understanding is always unique.

Finally, I wish to record my greatest debt to my loving parents whose support and love are beyond words. I would also like to devote this research to Buddha for his mindful awareness and deep concern for all beings.

Dedication

to

All the learners who are enduring lack of attention at all levels of education, and

to all the children who are victims of war or religious disagreements throughout the world.

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Chapter One

Introduction

1.1 Rationale

The principal aim of this study is to provide an account of the relationship between staff research and teaching in doctoral education with a special reference to disciplinary variation.

The relationship between teaching and research has recently been a controversial issue in higher education (Horlock, 1991; Barnett, 1992, 2000; Hattie & Marsh, 1996; Harris Report, 1996; Elton, 2000; Rowland, 2000a, 2000b). The relationship matters, partly because of its implications for higher education structure and resources and partly because of its intrinsic importance in helping to define higher education, especially the role of the university. More importantly, the nature of the relationship bears on the quality of university education.

The claim that staff research will enhance teaching and learning has been revealed in many places, such as The Robbins Report (1963: para 556, 557). The mutual reinforcement between research and teaching is accentuated. A contrasting view contends that because of the scarcity of time, energy and commitment, research and teaching are more likely to interfere with each other rather than enhance each other. (Linsky & Straus, 1975; Faia, 1976) It is also argued that because research and teaching are different activities, they are not related. (Barnett, 1992)

Yet focused, evidence-based, attention to the relationship has been relatively rare especially at the level of doctoral education. Moreover, even fewer studies aim to investigate the subject matter from the student's perspective. Although Hargens (1975) showed that a strong association between numbers of graduate students and research productivity is found in Chemistry, but not in mathematics and political science (cited in Kyvik and Smeby, 1994), issues like the relationship between staff research and research students' learning, research students' perceptions of staff

research, and the possible disciplinary variations in doctoral education are largely unknown and require further investigation.

In addition, in the UK, research training has not so far been included in teaching quality assessments so there is at present no independent evaluation of the quality of doctoral education and training of research students.

This research aims to explore how disciplinary differences between Chemistry and Education in terms of paradigm consensus, learning styles, nature of knowledge and communication patterns (see discussion in section 5.1) influence the ways and the extent to which research and teaching are connected. While the topics I will be dealing with have not been entirely ignored in recent years, they have not received a great deal of direct attention either. This is largely because many people until recently assumed that staff research and teaching in doctoral education are positively related. Little research has been conducted at the doctoral level. Furthermore, the disciplinary variation (Becher, 1984, 1987a, 1987b, 1989; Becher & Trowler, 2001) is also important in this relationship and in doctoral education. Hence the argument of this study is that the widespread belief of a positive relationship in doctoral education needs to be carefully scrutinised especially in the context of disciplinary differences.

1.2 Definitions of Research and Teaching

For the purpose of this study, I have taken 'research' to mean moving forward of the frontiers of knowledge or the pursuit of new knowledge in any discipline. It manifests itself in either making new discoveries or providing a new perspective for understanding existing data. At the individual level, it looks at the research activity of this sort conducted by a person. At the aggregate level, it refers to the overall research activities of this type carried out in an institution or a department. The reason for defining research as such is because it is the most portmanteau and convenient meaning of the word. The majority of the arguments on the relationship between research and teaching refer to this meaning. (Newman, 1960; Faia, 1976; Centra, 1983; Barnet, 1992, 1997; Clark, 1991; Rowland, 1996; Elton, 2001) It also underpins most of the discussions regarding research rewards (Fairweather, 1993),

research funding (Brown, 1993; Jenkins, 1995), and research policies (HEFCE, 1996; Williams, 1984; Broadhead, 1998). There are, of course, other definitions, such as treating research as a form of advanced study or a way of advanced thinking. However, this kind of definition overlaps with 'scholarship' and is less likely to be referred to in practical contexts. Consequently, it is believed that the above succinct and widely shared definition is appropriate for this study. (CVCP, 1985; Feldman, 1987; Hattie & Marsh, 1996; Noser, 1996; Serow, 2000)

I define 'teaching' as the activities that facilitate understanding, impart information, transmit structured knowledge, bring about conceptual change and teacher-student interaction (Kember, 1997: 262), and support student learning (Chalmers & Fuller, 1996: 9; Samuelowicz & Bain, 1992: 106-107). In other words, at the individual level, "great teachers create a common ground of intellectual commitment. They stimulate active, not passive, learning and encourage students to be critical, creative thinkers, with the capacity to go on learning...indeed, as Aristotle said, 'Teaching is the highest form of understanding'." (Boyer, Times Higher Education Supplement, 12/12/1990: 13 quoted in Pennington, 2001: 6) They facilitate a deep approach of learning in students. (Biggs, 1999: 54) At the aggregate level, an education institution or department provides "hidden curriculum" of this sort to facilitate and support student learning. (Heywood & Hides, 2001:19)

1.3 Contributions and Boundaries of This Study

Through this study, it is hoped to contribute to knowledge of higher education in three areas. First of all, the study aims to shed light on the relationship between research and teaching at the doctoral level.

Secondly, it will further understanding of disciplinary differences in doctoral education. The significance of the diverse academic cultures has been revealed in an extensive literature. (Snow, 1959; Hudson, 1966; Lodahl & Gordon, 1972; Biglan, 1973a, 1973b; Kolb, 1981; Becher, 1984, 1987a, 1987b, 1989; Becher & Trowler, 2001) However, very little is known about how it is manifested in doctoral education

and how it bears on the research/teaching relationship. This study attempts to look at possible disciplinary variations in doctoral education.

Thirdly, while this study has tried to investigate the relationship between research and teaching in doctoral education, special reference to the perspectives of students on the subject matter has been highlighted. This study is intended to underline the significance of the students' voice with regard to the debate about the relationship between research and teaching.

Of course, there are boundaries. Due to the limited time and resources of a PhD study, the empirical research is restricted in four ways. Firstly, only full-time doctoral students are included. Thus the findings of this study may have little bearing on the doctoral education offered to part-time doctoral students.

Secondly, only one subject from the social sciences and one from the natural sciences are investigated. This means that caution should be taken in generalising the results to other subjects in either the social sciences or the natural sciences.

Thirdly, the empirical evidence is from only one country, UK. Caution should be taken again in applying the wider implications of the findings to other places, because doctoral education systems vary between countries.

Fourthly, I myself am a doctoral student – I am part of what I am writing about, and this in one way could help me to understand doctoral students' perceptions of their study. The more I understand other fellow students' experiences, the more I hope that I will genuinely and truthfully reflect their views. It also gives me strength in overcoming the difficulties that I had with my own PhD research and keeping me going. However, in another way it could affect the objectivity of the study and I have attempted to counter this as much a possible by presenting my findings at seminars and conferences attended by academic staff – and of course my supervisor, a senior academic, has helped to counter balance any bias in my interpretations.

1.4 Structure of the Chapters

I will conclude these preliminaries by providing a brief outline of this thesis.

I begin by considering the conceptual discussions and debates about research and teaching. Chapter two is devoted to examining three possible permutations of the argument about research and teaching: Complementary relationship, Competitive relationship and Neutral relationship. I provide a historical account of the development of the research orientation of universities, followed by a discussion on the three types of relationships with special reference to doctoral education at both the individual and aggregate levels.

Chapter three consists of a general overview of the empirical findings. Important studies from the 1990s are reviewed and discussed. Chapter four focuses on the current situation and issues of doctoral education with a special reference to UK universities. It further examines empirical studies pertaining to the relationship between staff research and teaching at the doctoral level.

Chapter five is devoted to the empirical research strategy of the study. The choice of subjects and the measurements of research and teaching are expounded. A questionnaire was distributed to full-time doctoral students in Chemistry and Education. It is supplemented by interviews. These are reproduced in the appendices.

Chapter six presents the statistical findings of the relationship between research and teaching with special reference to disciplinary variations. Chapter seven is composed of the findings from the follow-up interviews. Chapter eight interprets both quantitative and qualitative findings. It concludes by highlighting the points in relationship to research and effectiveness of doctoral education, which need further investigation.

Chapter Two

Relationships Between Research and Teaching

This chapter focuses on the conceptual relationship between research and teaching. In doctoral education, students' work is closely related to research. Therefore, a prevailing belief is that staff research and doctoral education must be related. However, this does not mean that it should be accepted without careful scrutiny. Many arguments have been generated to support the possible permutations regarding the relationship. The first section wi'l give the historical account of this debate. By the end of the twentieth century, research-oriented universities had become the mainstream of higher education. The relationship between research and teaching has been constantly debated. The significance of the Humboldtian university is highlighted.

More recently, three major theories with regard to the contemporary research/teaching debate are outlined: Complementary, Competitive and Neutral relationship. The second and third sections aim to delve into the debate in the light of the three major theories from the individual and aggregate perspectives.

2.1 Development of University as Research-Teaching Institution

The university, a formalised institution of higher education, can be traced back as early as 140-186 BC in China, eleventh century AD in Bologna or twelfth century AD in Paris (Domonkos, 1977; Cobban, 1975l; Manrakhan, 1990; Perkin, 1991), but its research task is relatively new (Wittrock, 1993). It was not until around two hundred years ago when Wilhelm von Humboldt established the Free University in Berlin in 1810 that the research function of the university started to be explicitly recognised. By the middle of nineteenth of century, "research became a necessary qualification for a university career and was considered as part of the function of the professor (although not an officially defined part)." (Ben-David, 1971: 108) Later research

gradually developed into an integral part of academic life in universities all over the world. (Clark, 1995: 20)

At the centre of the Humboldt reform was an advocacy of the fusion of research and teaching. The underlying theory is that the university is not only for teaching young adults, but also for maintaining and discovering knowledge. This means that the university is distinctive from institutions with only a pedagogical function. Theorists who believed in this view thought that what made a university distinctive is its "more rigorous and systematic" nature. (Brandes, 1802, cited in Turner, 1975: 517) It is because this "more rigorous and systematic" nature in the concept of university that the research scholarship has come to the centre of academic stage. From this point of view, knowledge itself or the contribution to knowledge is underlined. In the Humboldtian era, *Wissenschaft*, "devoting oneself to science", was regarded as the destination that all scholars and students should aim for. (McClelland, 1980: 123) The essence of university consisted in *integrated*, *meaningful* and *pure* knowledge. For Fichte, Hegel and Goethe, the pursuit of that knowledge is "the highest calling of man." (McClelland, ibid.: 124) In the light of the neo-humanism and idealism, the process of seeking pure knowledge is also the process of self-development. (Ringer, 1969: 93; McClelland, ibid.) Going beyond the limits of one's knowledge and enquiring into the unknown world were perceived as the ultimate purpose of university education.

In order to pursue absolute truth, academic freedom was considered to be necessary for both professors and students. In Humboldtian universities, the classroom is the place where both professors and students work together to explore and discover new knowledge. In an ideal lecture, according to McClelland (ibid.), both professors and students started with brainstorming and later brought about discovery by sharing, inspiring and criticising each other's views. This may sound perfect but in practice, some problems are encountered. Take the subject of classical philology in the nineteenth century for example, according to Grafton (1983), due to the new arrangement of lectures or seminars, students at that time found that they did not have a consistent view of the broad picture of the subject. They even had difficulty in drawing the picture of individual classical writers. In their opinion, the reason for these was that they knew too much to understand it. Lectures or seminars were

directed in a way that attention is only paid to detailed things. From their point of view, the courses were designed for the benefit of specialists rather than learners. Sharing a similar view with students, professors found that the introduction of contentious issues and criticism did sometimes interfere with reading and learning.

By the end of nineteenth century, German universities had become famous for their research and research training. They attracted students from England and America (Clark, op. cit.: 20) "Until about the 1870s, the German universities were virtually the only institutions in the world in which a student could obtain training in how to do scientific or scholarly research." (Ben-David, 1977: 22) Compared with the traditional universities, some features of the Humboldtian universities are summarised in the following Table 2-1:

Table 2-1: Comparison between Traditional and Humboldtian Universities

	Traditional University *Teaching oriented*	**Humboldtian University** *Research oriented*
Lecture	• Fixed knowledge • Reading texts	• Open knowledge: knowledge & methods • Sharing research results
Laboratory	• Training for pharmacists • Private endeavour of the professors	• Training for both pharmacists and researchers • Joint endeavour of the professors and students
Seminar	• Training for high school teachers • Training to explicate text, e.g. grammarians	• Training students to do independent research work
Role of Research	• Casual • Personal vocation	• Professionalised • Career pattern

(source: compiled by the author from the materials discussed in the text.)

The unconventional device for universities generated by Wilhelm von Humboldt is that:

> One unique feature of higher intellectual institutions is that they conceive of science and scholarship as dealing with ultimately inexhaustible tasks: this means that they are engaged in an unceasing process of inquiry. The lower levels of education present closed and settled bodies of knowledge. The relation between teacher and pupil

> at the higher level is a different one from what it was at the lower levels. At the higher level, the teacher does not exist for the sake of the students; both teacher and student have their justification in the common pursuit of knowledge.
>
> (Humboldt, 1970 translated by Shils quoted in Clark, 1995: 19)

The new Humboldtian university, basically, distinguished itself from the traditional ones by stressing the importance of scientific research. This research-oriented nature manifested itself at least in four aspects of the university education: lecture, research laboratory, seminar and the role of research. To begin with, lectures were mainly composed of texts or more fixed knowledge in traditional universities. Professors prepared important texts and explained them line by line and word for word. "Often, a set of lectures provided little or nothing more than could be found in a published commentary on the text in question." (Grafton, op. cit.: 163) In contrast, professors in the Humboldtian university were asked not only to present the knowledge but also to discuss the methods and research results of their own or others in the discipline. (ibid.) German professors were not constrained by the curricula approved by the ministries of education at that time. Consequently the topics of their specialised research could be brought into the courses. (Ben-David, 1977: 98) Compared with the closed knowledge in the traditional universities, the knowledge presented in the lectures in Humboldtian universities was more open.

Another feature of Humboldtian universities is the teaching-research laboratory (Ben-David, 1971: 123-126; Ben-David, 1977: 97-100; Clark, 1995: 24-26). Science laboratories were originally a private effort of some teachers or professors to give practical training for pharmacy students. (ibid.) The initial design of the laboratories was not meant to train students to become research workers. The laboratory only provided what students would practically need for their future work as teachers or pharmacists (Gustin, 1975; Paulsen, 1921: 258-259 in Ben-David, 1977: 98). However, the laboratory experienced a revolutionary change during the university reforms at the beginning of the nineteenth century. The most famous example is the Chemistry laboratory of Justus Liebig in Giessen. "Those prominent chemists of the later nineteenth century who are commonly identified with Liebig's school [in mentor-apprentice chains] make up only a small minority of the more than seven hundred persons who spent time in the laboratory at Giessen during the twenty-eight

years in which Liebig presided over its operation." (Holmes, 1989: 122 quoted in Clark, 1995: 24) Within fifteen years of its opening, the Liebig laboratory had already reached its unbeatable international status and had more than fifty students at a time by 1840s. (Clark, ibid.) "Liebig's command of so large a group of advanced students to whom he could give experimental projects useful both to their training and to his interests enabled him to exploit new research openings with a swiftness that made it hard for chemists operating alone, or with only a few students, to compete with him." (Holmes, 1989: 162-163 quoted in Clark, ibid.: 25) The extraordinary success of Liebig laboratory in Giessen became a model for other universities to reflect on their own research training programmes. (Holmes, 1989: 121 in Clark, ibid.: 24; Ben-David, 1977: 98)

What makes the reformed laboratories distinctive is the introduction of a research training function. In contrast to the personal attempts of training future pharmacists in traditional small laboratories of pharmacy, the teaching-research laboratories are characteristic of both their training for pharmacists and for researchers. (Ben-David, 1971) "This transformed the integration of research with teaching, as well as the relationship between research and general education on the one hand, and training for the professions on the other." (Ben-David, 1977: 100) In other words, the teaching-research laboratories not only aimed at teaching and training pharmacists and physicians, but also provided scientific training for students who were interested in doing research. "Research ceased to be conducted in privacy, but began to be carried out in the community of teachers and students." (Ben-David, ibid.: 100) For example, Liebig was able to set research questions for students. "He invented simpler and more reliable instruments for chemical analysis, making it possible for students of varying levels of insight and skill to routinely produce elementary analyses at a much accelerated rate." (Clark, 1995: 25) Research in sciences is no longer a "private activity". It is a joint endeavour both from professors and students. By the middle of the nineteenth century, the teaching-research laboratory had become the fundamental structure of science education in a university. (ibid.)

Seminars had existed for about two thousand years before they were committed to research methods in Humboltian universities in nineteenth century. (Olesko, 1991 in Clark, ibid.: 26) They were originally aimed to train students to become good

'gramarians', preachers or high school (*Gymnasium* or *lycée*) teachers in elucidating texts in the classroom. (Grafton, 1983; Clark, ibid.; Ben-David, 1977: 99) The seminars "had evolved from informal meetings of professors and students, replacing 'the monologues of lecture courses with dialogues between professors and students' and thereby 'helping to transform the nature of teaching and of learning.'" (Olesko, 1991: 1 quoted in Clark, ibid.: 26) They were composed of intensive courses especially for '*Gymnasium* teachers' in classical languages. (Ben-David, 1977: 98) Therefore, students' ability in explication and communication was stressed. (Grafton, 1983)

In the Humboldtian era, seminars gradually transformed into teaching research methods. (Clark, ibid.: 27) Training students to do "independent work" became one of the main objectives. (Grafton, ibid.) The enterprise of discovery and creation, which no longer belonged to individual scholars, was both joined by teachers and students. One of the examples is the mathematics-physics seminar run by Franz Neumann in Königsberg in 1834. (Clark, op. cit.: 27) The agenda of the Neumann seminars included "practical exercises in techniques of quantification, group review of problems and innovative design of instruments." (Clark, ibid.: 27) This seminar also served as a link between individual student's homework problems and the professor's teaching laboratory. (ibid.) The Königsberg seminars offered not only the training for using the techniques in scientific research but also the training of the mind of investigation. (Olesko, 1991: 15,17 in Clark, ibid.: 27) In other words, students were expected to be 'independent researchers' at the end of the course. They were encouraged to be critical and create better works. The classroom became a place where both professors and students pursued knowledge together. As a result, the success of German research universities consists in the chair-controlled institutes, seminars, laboratories and even hospitals, which were "comparatively small and highly autonomous self-contained units of academic production" (Mommsen, 1987: 65 in Clark, ibid.: 28).

From the above reasons, it is not surprising to find that research was differently perceived in the Humboldtian universities. Before the nineteenth century, academics conducted research out of personal interest. "Research was conceived as work done in privacy and freedom." (Ben-David, 1977: 97) By the first half of the nineteenth

century, a young English man could do research "only if he could afford it as a hobby or if he was devoted to science to an extent that he was willing to face real deprivation for its sake." (ibid.) Although the situation was slightly better in France, young people who were interested in research had to obtain jobs which could enable them to pursue research in leisure hours. "Both in England and in France, however, the initial opportunity to go into research was the result of means or positions attained for other reasons." (Ben-David, 1971: 124) Research was carried out in a casual way and was regarded as a type of personal vocation.

In contrast, research had been gradually transformed into a career in German universities during the Humboldtian era. Ben-David argued that because there was an academic market for researchers in German universities at that time, it was possible for students to do research at the universities and commit themselves for four or five years to the thesis. It was regarded as an entrance for a well paid research job at that time. (Ben-David, 1960; 1971: 124; 1977: 98-99) In addition, the strong demand for the scientists ensured the support of the government and the university towards the laboratory research. (Zloczower, 1966 in Ben-David, 1977: 99) Consequently, "academic policies were guided by the needs and potentialities of creative research." (Ben-David, 1971: 123) In both cases of the reformed laboratories and seminars, "research now moved much closer to professional training than to general education. It was integrated with the former but sharply distinct from the latter." (Ben-David, 1977: 100) Research in Humboldtian universities therefore, was much stressed and professionalised. (Torstendahl, 1993) Academics were asked or strongly encouraged to conduct research. Research gradually became an integral part of an academic career.

2.1.1 Research/Teaching Debate at the Turn of 18th and 19th Century

The relationship between research and teaching experienced a great transition at the turn of the eighteenth and nineteenth century. Three standpoints are distinguished: teaching-focused position, positions of pedagogical publication and specialised publication.

The first perspective, in the light of the German utilitarianism, drew attention to the importance of teaching in university education. (Ringer, 1969: 85; McClelland, 1980: 106) It is believed that the essence of a university lies in education. The education of the young is the most crucial objective of a university. How to cultivate and improve the young minds in the university became the main concern. In practice, Socratic teaching methods, fundamental courses and discipline of students were stressed. The representative theorist at that time is Michaelis, a professor in University of Göttingen. He asserted that the professor *is* mainly a teacher. (Michaelis, 1768 cited in Turner, 1975) The professor is not obliged either to publish or to make discoveries. Michaelis went on to maintain that if a professor's teaching is poor, the poor teaching cannot be compensated by any of his other activities in any case. (Michaelis, ibid.) This means that teaching or education is the foremost duty for professors. A person who is not a good teacher cannot be a good professor regardless of how good he/she might be in other areas.

However, this view was not shared with people who are concerned with matters like finance and reputation. In the eighteenth century, the heart of the debate on teaching and research involved issues of funding and prestige. (Turner, 1975: 517-518) The literary works created by professors promote the reputation of the institution abroad, which in turn lead to the prosperity of the institution due to the increase of students and incomes. Professors were expected to produce or publish as many literary works as possible. In other words, the educational duty of a professor, for those people, is subordinate to the duty of raising the reputation and funding of the whole institution. This view was challenged by Michaelis and his supporters. They distinguished a professor from an academic who is also a famous writer:

> Must professors in general be writers—famous writers?--This is a new question to which one will expect an answer.
> In fact I do not believe that this is an indispensable characteristic of a good professor; and where it is emphasised too much I suspect that the authorities...do so not merely for the effectiveness of the university or the advance of learning, but rather to do something to raise the prestige of the university.
>
> (Michaelis, 1768: II, 225 cited in Turner, 1975: 518)

Jacob (1798: 254-255 in Turner, ibid.: 516) described professors who indulge only in writing as "scholarly monsters". Those professors were criticised for doing very little for students, not bothering to make an effort with the lectures and only caring about themselves. What Jacob and Michaelis cherished more is a professor who really cares about the learning of students. They suggested that the recruitment of academic staff should be based not only on the judgement of a person's knowledge but also his/her communication skills in terms of teaching. In their opinion, "professors should not strive to be literary figures". (ibid.) It was not against the conception that a professor could be both a good teacher and a famous writer. It was claimed that a professor who is a competent teacher has already fulfilled his duty.

However, not everyone agreed with this line of reasoning. For some people, publishing was just as important as teaching. There were two connotations of 'actively publishing' in the eighteenth century. The first one referred to pedagogical publication, or in Turner's term, "textbook tradition". (ibid.: 523) The second one, which appeared later, was referred to as research publication.

In the pursuit of pedagogical publication, professors would focus on writing handbooks, translations and materials of a pedagogical and encyclopaedic nature. It was for the teaching requirement and the transmission of knowledge at that time. Their publications were targeted for classroom students and the public. In contrast to the works published by modern academics, they were hardly addressed to the specialised academics. (Turner, ibid.) Owing to this, the intellectual abilities of synthesis and communication (such as sensitivity to the coherence of the parts, boundary of the knowledge and clarity in explaining and presenting materials) were more valued than other abilities like creation and discovery.

People who support this view believed that publishing pedagogical materials is the best way to help professors construct their knowledge and prepare for lectures. (Hoffbauer, 1800 in Turner, ibid.) They also believed that the work of pedagogical materials such as the textbook with the requirements of broad, systematic knowledge and illuminating presentation is the highest form of all kinds of publications. Furthermore, pedagogical publications are also a good reference in terms of accountability: it allows outsiders to understand and judge the lectures in one

particular university. For these reasons, the advocates of pedagogical publications were also encouraged by the German government by decrees in 1737 and 1768. (Turner, ibid.)

In a way, the 'textbook tradition' is a real combination of publication and teaching. Different from other research-stressed theories, pedagogical publications are not for harnessing academic reputations although it may turn out as a result or bonus. However, it is primarily for teaching purposes. Having addressed this, like other views stressing the importance of research, it also has to face challenging questions. For example, in the nineteenth century, this view of pedagogical publications was criticised for its encyclopaedism and for not being scientific. (McClelland, 1980: 123)

Apart from pedagogical publications, the second view accentuates the kind of publications that concern new knowledge. It was believed that due to the contribution of the publications to the reputation of the university, academic publishing activities should be encouraged. The underlying theory is that the academic reputation is, if not more important, at least as important as quality teaching. Theorists who take this position believed that writing for publication gave the opportunities for professors to be known abroad and to promote the name of the university. (Brandes, 1802 in Turner, op. cit.) This concept influenced how people perceived the publishing activities of a professor and scholarship at that time. Owing to the fruitful benefit to the academic reputation, professors whose teaching was poor or who only took small numbers of students were accepted and tolerated as long as they were distinguished writers. This perspective fostered the idea that a professor should also be a famous scholar through publication. Research and publication were gradually more recognised as an obligation in terms of scholarship.

2.2 Individual Perspective

Three major theories pertinent to the contemporary debate of research and teaching are found: Complementary relationship, Competitive relationship and Neutral relationship. The first permutation maintains that staff research and teaching are complementary: they are positively related. In other words, an academic who is successful in research is automatically certified as a good teacher; a department with a successful research reputation as a good provider of university education. Therefore, these two are transferable, interchangeable and can enhance each other. Staff research and teaching are perceived to have a symbiotic relationship. In contrast, it is argued that staff research and teaching are competitive. Each of them consists of various parts that are incompatible to each other. They are at least in part, in conflict with each other or get in each other's way. On the other hand, it is also contended that there is no relationship between the two; staff research and teaching are so different that they have nothing to do with each other.

With reference to the research/teaching relationship at the individual level, two major arguments support a complementary relationship; five support a competitive relationship and another five support a neutral relationship. These are summarised in Table 2-2.

2.2.1 Complementary Relationship

The arguments that support a complementary relationship between research and teaching at the individual level can be categorised into two groups: (1) research is an inherent feature of a university teacher, and (2) research and teaching are complementary.

To begin with, people who argue for the unity of teaching and research at this level tend to think that doing research is a distinguishing feature of university teachers in higher education. It is the research, the "independent enquiry", that attracts people to becoming university teachers (Williams, 1991) and makes higher education distinctive from other types of education (Scott, 1991). This view is especially

Table 2-2: Relationship between Research and Teaching from the Individual Perspective

Complementary Relationship	Competitive Relationship	Neutral Relationship
Research and teaching are positively related because: • Research is a distinctive feature of a university teacher; (Scott, 1991; Ball, 1992: 133; Sutherland, 1994; Rowland, 2000b: 2) • Research and teaching are different but are complementary; a. Research and teaching enhance each other; (Robbins Report, 1963: para 556, 557; Ball, 1992: 133; Horlock, 1991; Hudson, 1999: 400; Rowland, 2000b: 1) a.1. Doctoral students are actually doing research and therefore only those staff who are actively engaged in research can uphold the high quality of supervision; (HERDSA, 1989; Neumann, 1992; Clark, 1995: 225) b. A good researcher means a good teacher and vice versa; (Cooke, 1998: 283; Horlock, 1991: 78, 83; Ehrlich & Frey, 1995; Furedi, 1998: 137) b.1 A good researcher means a good supervisor. (Smeby, 1998; Hudson, 1999: 400; Rowland, 1996; Centra, 1983; Melland, 1996; Hanson, 2001: 111-112; Rowland, 2000b: 2; Brew & Boud, 1995: 266-268)	**Research and teaching are negatively related because:** • One's time and energy are confined; (Faia, 1976: 240; Linsky & Straus, 1975: 91; Trice, 1992; Moore, 1963: 108; Neumann, 1996; Moses, 1990; Edgerton, 1993; Smith, 1990; Jencks & Riesman, 1968: 532) • Research and teaching are conflicting functions; (Ben-David, 1977: 94; Fox, 1992: 293; Light, 1974: 8; Clark, 1986: 25; Ladd, 1979; Eble, 1976; 19; Butlin, 1999: 398) • Disparity between the aspects of knowledge that research and teaching are engaged; (HERDSA, 1989: Prosser; Clark, 1995: 193; Ben-David, 1977: 93-94; Faia, 1976) • Disparity in the areas of research and teaching profession; (Faia, 1976: 241; Williams, 1984; Barnett, 1992 & 1997: 110; Fairweather, 1993) • Disparity in the rewards of research and teaching. (Williams, 1984; Brown, 1993; Faia, 1976: 243; Rowland, 1996: 10 & 2000a, 18; Yorke, 1999 in Jenkins, 2000: 337; Edgerton, 1993; Moses, 1990)	**Research and teaching are not related because:** • Being a researcher and being a teacher are two different roles; (Finkelstein, 1984; Linsky & Straus, 1975; Rowland, 1996; Rugarcia, 1991 in Hattie & Marsh, 1996; Barnett, 1992: 633) a. Researcher and teacher have different personal traits; (Rushton, Murray & Paunonen, 1983 in Hattie & Marsh, 1996: 514) b. Being a researcher and being a supervisor are two different roles; b.1. There are other significant factors than subject knowledge in becoming a good supervisor; (Bennett & Knibbs, 1986; Phillips & Pugh, 1987; McMichael, 1993; Fallow, 1996: 150; Thorley & Gregory, 1995: 89; Salmon, 1992: 89; Elton, 2000: 258; 2001: 52) • Research is not the only way to understand the provisional and uncertain knowledge; (Barnett, 1992: 630-631) • Scholarship of teaching is different from scholarship of discovery and should be celebrated; (Elton, 1992; Rice, 1992: 118; Boyer, 1990; Handlin, 1986; Andresen, 2000: 25-26) • The experience of good supervisors is not necessarily related to their research performance; a. Research knowledge of the supervisor alone cannot respond to the complexity of doctoral education; (see Table 2-4) • Experience of good teachers for students is not necessarily related to their research performance. (Elton, 2001: 51-52; McGee, 1984)

presented by Ball: "it is one of the non-negotiable defining features of what is meant by *Higher Education* that the teaching is provided by those who are themselves active in research." (original italics, 1992: 133) The theory that has been quoted by the thinkers along this line is in the Sutherland 1993 lecture "The idea of a University" (Sutherland, 1994):

> Any subject which is a genuinely a university subject will be one which is capable of further development....It is here that we shall find the genuine logic for locating teaching and research in the same institution. The argument is not that inevitably every good teacher must be a researcher. It is more subtle than that. It is rather that the fields of study appropriate for university degree work are such that, in principle, they extend to boundaries which are not their final resting place - or, more dramatically, that from the first undergraduate introduction to them they extend, so to speak, to infinity, or to that particular frontier of human knowledge. If education is to be offered, and understanding is to be the outcome, then a crucial element of that understanding must be that our knowledge is not complete, that further extension beyond the current limits of our grasp for the subject is both possible and required. To grasp that is to be aware of what research in that subject could mean. To educate in that subject is to be aware of what the current limits are and, in principle, where the points of development might be.
>
> (Sutherland, ibid.: 9-10)

It is believed that knowledge involved in higher education is unique. Different from knowledge elsewhere, it is more provisional, uncertain, and open to criticism. The borderline is still hazy. The tentative knowledge at this level needs further exploration and investigation. "If students are to be taught to think *critically,* knowledge should always be presented to them as being contestable" (Rowland, 2000b: 2) Due to this nature of knowledge in higher education, university teachers, the argument goes, have to be active researchers. There are two assumptions at work here. Firstly, teachers can hardly bring their students to this level of understanding without being active in research. "This means presenting students with knowledge as if it were new and provisional, approaching it in the spirit of the researcher who is concerned to test it and contest it with the students." (ibid.)

Secondly, teachers cannot reach this level of understanding in the field and therefore cannot be at the frontier of knowledge unless they are active researchers. For example,

Hutchinson claims in the book, The American Scholar (1966), that "The fact is that no very vital instruction of any kind can be carried on without scholarly books and the studies and monographs that undergird them." (cited in Smith, 1990: 178) People who possess these assumptions believe that being active in research will advance and renew one's knowledge. It keeps the teacher up to date with the latest information. It hence helps "keep faculty teaching fresh" (Fairweather, 1996; Rowland, 1996) and prevent "naïve generalisations and dogmatism." (Leal, B. in HERDSA, 1989)

This also leads to another argument: research and teaching are different but are complementary. The concept that research will enhance teaching and learning has been revealed in many places. For example, Ball strongly argues that "teaching and research are as inseparable as wool and mutton on a sheep-farm, that they mutually reinforce one another." (1992: 133) The Robbins Report (1963) accentuates the enforcement between research and teaching:

> There is a reciprocal benefit to those engaged in research from being members of an institution where learning is not only advanced but communicated. Contact with able and lively young minds, and the setting of the teacher's own preoccupations in a wider context which, the preparation of lectures demands, are of positive use as well as a source of refreshment.
>
> (Robbins Report, 1963: para. 556)

> There is no borderline between teaching and research; they are complementary and overlapping activities. A teacher who is advancing his general knowledge of his subject is both improving himself as a teacher and laying foundations for his research. The researcher often finds that his personal work provides him with fresh and apt illustration which helps him to set a subject in a new light when he turns to prepare a lecture.
>
> (ibid.: para. 557)

The complementarity of teaching and research posits that research has a positive effect on teaching. It includes the concept that doing research will keep teaching materials at the highest quality and up to date. (Horlock, 1991) "Teaching can be and is enriched by drawing upon the ongoing research of staff." (Hudson, 1999: 400) For people arguing along this line, research contributes to the dissemination of the latest advanced knowledge.

Next, publication is perceived as a way of teaching. (Robbins Report, op. cit.) For example, doing research is not different from teaching because "researchers must be able to communicate their ideas (teach), and learn from their experience (as students); otherwise they will fail as researchers." (Rowland, 2000b: 1 original words in brackets) Furthermore, "academics talking about their investigations to colleagues at a conference are engaged in research activity. Giving the same talk to students is thought of as teaching. In both instances the academic is teaching the audiences, and they are (hopefully) learning." (Rowland, ibid: 2)

This line of reasoning is especially argued in doctoral education. It is contended that because doctoral students are actually engaged in research, the staff who are responsible for research students have to be actively and successfully engaged in research if high quality of supervision is to be guaranteed. Thus, it is strongly argued that research and teaching mutually enhance each other at the doctoral level. (HERDSA, 1989; Neumann, 1992) It is perceived that research will benefit teaching more when academic staff are teaching at a higher level of education. Therefore, "professors typically desire to teach at the graduate level, for it is there that research, teaching, and study can clearly be fused." (Clark, 1995: 225)

They also believe that in some disciplines of doctoral education knowledge accelerates so fast that the textbooks cannot keep up with the latest development. It is only active researchers who can give students the most up-to-date information and teach at such an advanced level of knowledge. (Neumann, op. cit.)

This concept leads to the second one, that the best researchers turn out to be the best teachers. "The best teaching and learning is led by the best researchers, provided that they are appropriately trained to teach." (Cooke, 1998: 283) Horlock has declared that "if the quality of university teaching is to be high class, alive and exciting, then academic staff must be closely in touch with research and scholarship, with latest developments in their subjects." (1991: 78) Furthermore, he asserts that every university teacher needs to do research: "I for one would not have entered university work unless I was certain that I could do both teaching and research and nor would those whose work I have quoted in this paper." (ibid.: 83)

People who argue for this perceive intellectual excitement as an essential element in teaching quality and believe it can only be brought to the classroom by active researchers. (Ehrlich & Frey, 1995) This "intellectual magnetism", they suggest, contributes to the students' learning motivation. Furedi wrote, "As a sociologist I have found that some of my most exciting teaching experiences have been about issues raised by my 'work in progress'" (1998: 137), although what the students think about it is unknown. Furedi believes that "drawing students into one's work is invariably a stimulating learning experience for both sides of the teacher-student relationship." (ibid.)

It is also termed by Linsky and Straus (1975) as a "spill-over effect". The excitement and involvement of active researchers stimulate students, who can then appreciate knowledge from the perspective of development. Research also upholds teachers' interest in the subject matter. In a similar way, the stimulation from teaching students also spills over into one's research. It is two-way communication. Based on the above ideas, it reasons that the quality of research represents the quality of teaching. There is no need to separately reward teaching effectiveness, because "research prowess can stand as a valid proxy for teaching quality." (Ramsden & Moses, 1992: 275)

This argument is supported by a similar reasoning. That is, supervisors can hardly bring their research students to this level of understanding unless they are active in research. People who argue for this point believe that at the doctoral level, only by being active in research can academic staff have up-to-date knowledge of developments in their areas and have a critical attitude towards that knowledge. (Smeby, 1998) This line of reasoning generalises that staff research and supervision are inseparable and interdependent. If staff research and teaching enhance each other at the doctoral level, then it can be expected that research students would be made fully aware of their supervisor's on-going projects and what exactly they are.

The other assumption underlying the complementarity of teaching and research is that teaching has a positive effect on staff research. It is believed that academics who are in daily contact with students will conduct research better, like Linsky and Straus's "spill-over effect" (op. cit.) as earlier discussed. "Good students can ask questions

that have research implications." (Hudson, 1999: 400) Teaching students will provide the necessary insights and refreshing thoughts for an academic enquiry. The challenges and stimulation from students and their projects give fresh ideas to staff to move into new areas of investigation. (Ramsden & Moses, op. cit.; Rowland, 1996) It is also believed that a person's general ability and energy levels decide both his/her teaching and research performance. (Centra, 1983; Melland, 1996) This means good teachers also possess the ability and energy to be good researchers. Hanson argues that the closest link between research and teaching actually lies in "involving undergraduates in the research process." (2001: 111-112) Therefore, it is claimed that good teachers and good researchers are closely and positively related.

In an attempt to flesh out a proposal of the Sutherland sort, Rowland (2000b) claimed that "academic work is not like that for university teachers, researchers or students". (ibid.: 2) These three roles cannot be separated:

> Researchers must be able to communicate their ideas (teach), and learn from their experience (as students); otherwise they fail as researchers. Teachers must be able to set a context with their students in which significant questions can be explored (research), and learn from these contexts (as students); otherwise they will fail as teachers. And students who are unable to investigate significant questions and communicate their findings – which are important aspects of teaching and research – will fail as students.
>
> (Rowland, 2000b: 1-2)

In a similar vein, Brew and Boud (1995) maintain that research and teaching are positively related because both are closely linked to learning. Research is regarded as an act of learning because they "both involve a process of exploration of existing knowledge, yet both seek to go beyond it." (ibid.: 267) On the other hand, "the only teaching which is valuable is, of course, that which leads to effective learning." (ibid.: 266) As a result, "teaching and research are correlated where they are co-related, i.e. what is being related are two aspects of the same activity: learning!" (ibid.: 268) This conception is further developed by Elton (2001). Elton postulates that it is the problem-based learning that formulates the conditions for a positive association between research and teaching.

2.2.2 Competitive Relationship

Do teaching and learning really need research to enhance them? Does that mean if something goes wrong with the teaching or learning, the teacher has to go back and reflect on his/her own research? Does it also mean that if someone's teaching is not to the required standard, we have to persuade him/her to do further research?

The proposals of the Complementary relationship sound plausible. However, from the standpoint of the Competitive and Neutral relationship theories, it could also be a one-sided reading of the situation. There are five major arguments with regard to why research and teaching are competitive, instead of complementary. The first is concerned with the limitation of one's time and energy. How much time does an academic require to devote to research and teaching? Faia (1976) argues that even if the complementarity of these two roles is true, it cannot deny the fact that the time and energy of one person is limited. "Only so much time and energy is available to any one person and commitment to either [role] prevents the development of excellence in the other role." (Linsky & Straus, 1975: 91 cited in Faia, ibid.: 240) The labour intensity of both teaching and active research performance makes it more difficult for an academic to excel in both roles. (Trice, 1992) "Given the scarcity of time and energy, the probability of role conflict for the multiple joiner is somewhat more than abstract and hypothetical." (Moore, 1963: 108) The competition for time and energy becomes more severe if one of the roles, which in most cases is the researcher, is given the priority. (Neumann, 1996; Moses, 1990; Edgerton, 1993; Smith, 1990) Academics "have only a limited amount of time and energy, and they know that in terms of professional standing and personal advancement it makes more sense to throw this into research than teaching." (Jencks & Riesman, 1968: 532)

People from the Complementary model may argue that the issue of competition for time and energy is suspect because both students and teachers are engaged in doing research in doctoral education, but this claim is itself suspect. Kyvik and Smeby (1994) find that many staff believe supervising research students takes away valuable time from their own research. Conversely, research students also feel that their supervisors' research prevent them from receiving adequate supervision. (Becher, 1994: 154) Welsh (1979) points out that research activity of the supervisor was

perceived as one of the three factors causing dissatisfaction with supervision. In some situations, there may be a danger concerning students' academic autonomy when students' research is taken over by the supervisors. For example, students' academic interests or work may be manipulated or violated to fit into staffs' own research interests. Some research students may end up being treated as "unacknowledged assistants" in the laboratory for the supervisor or as "cheap teaching force" for the department. (Brown & Atkins, 1988: 117)

Next, teaching and research can impede each other not only because they actually compete for time and attention, but also because they are two incompatible functions. "In spite of their close relatio ıship – they have different aims and requiıe different approaches, different talents, and different facilities." (Ben-David, 1977: 94) In other words, "research and teaching are conflicting roles with different expectations and obligations." (Fox, 1992: 293) An academic's orientations and investment in research and teaching are found to be in "constant tension" (Light, 1974: 8) and an "uneasy division of labour." (Clark, 1986: 25) The activities of these two roles are "at odds" with each other. (Ladd, 1979) Furthermore, Eble (1976) contends that a researcher and teacher require almost contrary personal attributes. Researchers are those who would like to "work alone, responds poorly to outside distractions and pressures, is more at ease with the stuff of ideas, facts, and materials of discipline than with students and learning." In contrast, teachers are those who would like to "seek out company, can handle pressures and distractions and prefers interacting with students to manipulate materials or ideas." (ibid.: 19) Hence, "a very important point that emerged from the symposium is that there can be no one single all-embracing formula or strategy for success in research and teaching." (Butlin, 1999: 398)

This view leads to another issue: how important is a teacher with cutting edge knowledge in the process of learning? The idea of needing a cutting-edge teacher assumes that learners depend on the teacher's knowledge to learn. This line of thinking suggests a "supplier-feeder" theory. Teachers are perceived as the knowledge supplier, while learners are seen as passive feeders. But does the learner always need a cutting-edge teacher? Is this the right training for independent learners that we expect from the higher education? Prosser (HERDSA,1989) highlights some disadvantages of having a teacher with cutting edge knowledge. For example, by

being actively involved in research, the academic tends to present him/herself as a subject authority in the classroom. This makes the teaching hardly interesting for students. It also makes the one-to-one contact between student and teacher difficult. In terms of subject matter, Prosser also doubts its long-term value for students. Due to the above reasons, "the students become inactive followers and learners." (Prosser, A. in HERDSA, ibid.: 7)

The third point is related to the disparity in the different aspects of knowledge that research and teaching are engaged. In terms of subject knowledge, there is an escalating gap "between frontier knowledge and teachable codified knowledge." (Clark, 1995: 193) Ben-David argues that "knowledge that can be taught no longer requires investigation, while knowledge that still needs to be investigated cannot yet be taught." (1977:93-94) The second type of knowledge that researchers are working on is, in his opinion, still developing and not far from struggling in the dark. Furthermore, some of this developing knowledge is difficult to categorise into certain disciplines. Given these conditions, research and teaching, in his eyes, interfere with each other.

With regard to the concept of knowledge, research and teaching are respectively attached to its different dimensions. At least three dimensions can be clarified: the discovery of knowledge, the transmission of knowledge (Faia, 1976), and more fundamentally the understanding and the application of knowledge. In the context of higher education, a teacher is closely related to the transmission of knowledge, while a learner is related to absorbing and applying knowledge and a researcher is closely linked to the discovery of knowledge. From this perspective, the argument of uncertain knowledge in a complementary relationship as earlier discussed is questioned. In the background of that argument, the assumption that a teacher cannot educate students prior to becoming a good researcher could be a mistake. That is, they have misunderstood the notion of the discovery of knowledge as the basis for the transmission of knowledge. As a matter of fact, the transmission of knowledge is not based on the discovery of knowledge and neither vice versa. It is the understanding and application of the knowledge that forms the basis for both of them. As research and teaching are related to different dimensions of knowledge, the disparity between them increases.

The fourth line of reasoning which supports a Competitive relationship concerns the disparity in the areas of the profession. Are teaching and research performed in the same areas of specialisation? "Institutional demands often are such that a given professor may find a large disparity between his research activities and his teaching, and presumably such conditions would tend to reduce complementarity." (Faia, ibid.: 241) Some may think that if that is the case, why not make the curriculum based on the knowledge that is directly transferred from the research output. Unfortunately, it can only be idealistic. Williams (1984) thinks that due to the development of specialised knowledge, what students ought to learn could greatly contradict the staff's research interests. He doubts how much the uncoordinated specialist courses can benefit the undergraduate learning experience. Next, it is simply not desirable to base the curriculum on staff research. Barnett (1992) elucidates that it is the educational objectives that the course should be driven from rather than the research projects. (see also Barnett, 1997: 110) Moreover, even if the staff's research projects happen to coincide with the curriculum, Fairweather (1993) asks: how can research enhance undergraduate teaching, when the full-time faculty doing the research are often not teaching undergraduates themselves? Presumably, the complementarity of the roles would be reduced by these conditions.

Last but not least is the disparity in research and teaching rewards. In many institutions, research is better rewarded than teaching (Williams, op. cit.; Brown, 1993). Faia (1976) maintains that the current reward disparities between research and teaching contribute little to role complementarity. In his opinion, rewards, such as deference, income, safety, can also motivate research and teaching to some extent since they are carried out in bureaucratic settings. However, in reality most of the rewards, promotion and tenure are connected with research and not with teaching. For example in the UK context, "the recent arrangements for funding teaching and research in British Universities were generally held to favour research measures rather than teaching measures as being the more significant determinant of future funding." (Rowland, 1996: 10; 2000a: 18) Of course, it can be argued by people in the Complementary model that since research enhances teaching, the more reward received by research will eventually be reflected in teaching. The issue raised here is that promotion and rewards are dependent more on research than on teaching. These

rewards disparities (Faia, op. cit.) will make institutions select professors who perform well in research and pay little attention to their teaching quality. While research is given priority, teaching is undervalued. (Edgerton, 1993) Teaching is perceived as a secondary occupation or a distraction from research (Moses, 1990) and therefore has a lower status than research. (Rowland, op. cit.) "... I feel pressure to do research [in order to] get more rewards for myself, at the expense of my graduate students. I feel pressure to get my graduate students to be as productive as possible so I can get my next merit increase or merit rewards." quoted from an academic in University of California, Berkeley. (Edgerton, 1993: 18) The result is that "the effect of repeated selection based on scholarly productivity, with little attention to teaching, would be to reduce the variance in scholarly productivity (while having relatively little impact on the variance in teaching skill), so that correlation between teaching and research would be substantially reduced." (in Faia, op. cit.: 243) It means, the argument of the role complementarity between research and teaching is difficult to uphold under these circumstances.

2.2.3 Neutral Relationship

Four major arguments support that there is no relationship between teaching and research. First of all, the roles of a researcher and teacher are independent of one another. (Finkelstein, 1984 in Braxton, 1996) They do not distract from each other. (Linsky & Straus, 1975) In the terminology, Rowland (1996) finds that the two roles are perceived and described in different vocabularies. For example, research is illustrated by terms like 'drive', 'self-motivation', 'stickability', 'confidence' and the ability to 'go out into the world and get it'. In contrast, teaching is closely linked to words like 'openness', 'concern for students', and 'caring'.

The values and activities around the two roles are also different. For example, according to Rugarcia (1991 in Hattie & Marsh, 1996: 513), researchers are treasured for their discoveries; teachers for their empowerment of their students to discover. For academic activities, researchers aim at searching for new knowledge; teachers aim at encouraging learners. The act of research is carried out mainly privately, whereas the act of teaching mainly publicly. Communication is a must in teaching, but

secondary in research. In terms of learning, learning by others is a "by-product" in research, but it is proposed in teaching and "is a direct consequence of teaching." (ibid.) In a similar vein, Barnett (1992) highlights the feature of a good teacher, which is not a characteristic required for a researcher. This is the ability to help students develop their own intellectual and professional independence. He points out that being a successful teacher goes beyond being a good researcher. This is because a good teacher not only has to interpret complex ideas, but also "galvanise their students into grappling with the issues for themselves". (Barnett, ibid.: 633)

Moreover, teachers and researchers have dissimilar personal traits. According to Rushton, Murray and Paunonen (1983 in Hattie & Marsh, 1996: 514), researchers and teachers are different types of people. Researchers are identified as "striving to create cognitive order, independence, achievement orientation and dominance" but teachers are "more easier going, intelligent liberality." (ibid.) For example, the personality traits of researchers tend to be "ambitious, enduring, seeking definiteness, dominant, showing leadership, aggressive, independent, not meek, and nonsupportive." (ibid.) Teachers are likely to be "liberal, sociable, showing leadership, extroverted, low in anxiety, objective, supportive, nonauthoritarian, not defensive, intelligent, and aesthetically sensitive." (ibid.)

This issue can also be explored from the viewpoint of the important roles and responsibilities of a supervisor. It is argued by the Neutral relationship theory that although subject knowledge is a must of a good researcher, there are other factors than subject knowledge in a supervisor, which can play a very crucial role in PhD students' training as a good researcher. For example, Bennett and Knibbs (1986) recognise ten important roles played by the supervisor and categorised them into four aspects: process roles, academic roles, interpersonal roles and validation roles. Phillips and Pugh (1987) summarise nine responsibilities of the supervisor. McMichael (1993) lists three points of desirable knowledge and skills of supervisors. These are presented in Table 2-3.

Table 2-3: Models of Supervisor's Roles and Responsibilities

Models	Supervisor's Roles and Responsibilities
Roles of supervisor (simplified) Bennett & Knibbs (1986)	*Process roles* • The Bureaucrat – dealing with the numerous forms required by the University and to ensure that regulations and procedures are adhered to. • The Initiator – initiating a number of events from progress meetings to the recommendation of an external examiner. *Academic roles* • The Expert – providing expertise. • The Mentor – providing guidance on a range of matters relating to the student's work. • The Innovator – stimulating the work of the student by adding new ideas. *Interpersonal roles* • The Friendly Helper – helping the student overcome difficulty • The Motivator – stimulating the student to see the value of the work undertaken. *Validation roles* • The Stern Critic – challenging the research student in order to develop the skills associated with defending the work. • The Evaluator – assisting research students to evaluate the work planned, in progress and completed. • The Judge – offering judgements which are crucial to the research student's progress.
Supervisor's responsibilities (adapted) Phillips & Pugh (1987)	1. supervise 2. read their work thoroughly 3. be available when needed 4. be friendly, open and supportive 5. be constructively critical 6. have a good knowledge of the research area 7. structure the supervisions 8. have sufficient interest in their research 9. be sufficiently involved
Desirable knowledge and skills McMichael (1995)	• Research knowledge and skills • Management skills: such as Dissertation management; Time management; Knowledge of procedures; Knowledge of resources • Interpersonal skills

From the analysis of these studies, it is obvious that not all roles played by the supervisor are directly related to their subject knowledge. In Bennett and Knibbs's model, it seems that the two process roles and two interpersonal roles are independent from the role of being a researcher. Only point 5 and 6 in Phillips and Pugh's model seem to be more relevant to the subject knowledge of the supervisor. In McMichael's analysis, apart from research knowledge, a supervisor is expected to have

management and interpersonal skills. All these studies highlight that there are other significant facets of supervision which are as important as the subject knowledge of a supervisor. In other words, being a researcher, no matter how successful he/she is, does not automatically certify the person's other abilities. Consequently, it would be inappropriate to assume that the excellence in subject knowledge can spontaneously transfer to other areas of supervision.

Furthermore, it can be dangerous if the subject knowledge of a supervisor is the only thing taken into consideration. For example, Fallow (1996) points out that there is a paradox between recruiting researchers to be lecturers. He states

> A second and, at least for the students concerned, potentially more damaging situation arises when universities take the view that the possession of a personal research track record automatically enables an academic staff member to supervise the work of students aiming for MPhil or PhD research degrees.
>
> (Fallow, 1996: 150)

In a similar vein, Thorley and Gregory assert that "the supervisor/student relationship often remains unchallenged and is vulnerable to misuse and abuse." (1995: 89) If this is the case, the question becomes: what is the relationship between the research productivity of the staff and the learning of research students? What is the role played by staff research in the research students' learning? Are there other significant factors influencing research students' learning experiences?

Fallow (op. cit.) points out that beside the subject knowledge-base of the supervisor, there are other aspects of supervision, like delivery and student motivation. Salmon (1992) also doubts the truth in the perception of the supervisor only from the knowledgeability. She highlights the importance of viewing supervision in terms of the relationship between the supervisor and his/her student. In her study of ten PhD students in Education, all of them talked about the importance of emotional support, when they were asked what they value in supervision (ibid.: 89). She argues that the basis of successful supervisory relationships lies in trust, sympathy and mutual resonance.

Following this logic, the idea that research and teaching are closely related because both are rooted in learning in the concept of the Complementary relationship (Brew &

Boud, 1995) is challenged by the Neutral relationship theory. The research-teaching-learning concept faces a number of difficulties. For example, it does not distinguish the different agents that the three activities - research, teaching and learning, relate to. If the above view that good researchers who have achieved good learning are good teachers is right, it seems reasonable to speculate that a teacher's learning or researcher's learning automatically grants students' learning. However, is this the case? A good teacher not only has the subject knowledge but also needs the knowledge of both how others learn about the subject and how to translate his/her own learning to others. The most obvious example is that "while in research, the level of understanding must be that of the researcher, in teaching it must be that of the student, not of the teacher. Thus, teachers have to perform an act of translation – from their own level to that of their students." (Elton, 2001: 52) It is this translation undertaking – from the teacher to the students – that differentiates researchers and teachers. Brew and Boud are right to highlight the learning element in doing research. However, it is important to recognise that a researcher's learning is one thing; teacher's and students' learning and the translation of knowledge is quite another.

Of course, some people in the Complementary relationship theory may still argue by raising the issue of the audience. Their contention is that because researchers have the audience to address, they are involved with others' learning, namely teaching, too. For example, Robbins Report claims that "publication is itself a form of teaching and many scholars have acknowledged that their published work has gained much from the discipline of the lecture, the class, and the tutorial." (1963: para. 556)

Needless to say, such a proposal is highly speculative, but from the perspective of the Neutral relationship theory, there is something wrong with it. When a researcher talks to the audiences or addresses to the readers, he/she is not 'responsible' for their learning. The researcher as the presenter or as the writer does not have to feel sorry if an audience or reader does not learn anything from his/her research. In contrast, the teacher is expected to be responsible for his/her students' learning. "As academics ... we have a responsibility for ALL our students, whether they are at university from a love of subject, because it gives them better job opportunities, because life at university is fun, or whatever other reason they may have, and it is our task to interest

them in and even enthuse them for our subject." (Elton, 2000: 258) Owing to this, the teacher has to know beforehand about the students' knowledge level regarding the subject, students' learning strategies, the best way to translate the knowledge and afterwards he/she is concerned with students' learning response. In contrast, what researchers have engaged is 'sharing' rather than 'teaching', at least not the kind of teaching that happened in an educational context. It is the responsibility of the students' learning and the difference between sharing and educational teaching that the roles of researcher and teacher are set apart even though both have audiences.

The second argument for the Neutral relationship theory is to recognise that research is not the only way of understanding the provisional and uncertain knowledge. This line of reasoning doubts the truth in the view that provisional and uncertain knowledge can only be understood by people who take on research projects. It is asked that: does a teacher or learner have to cross the frontier in order to understand the knowledge? Can one reach the frontier without actually moving it? Barnett (1992) draws an analogy between a musical soloist and a teacher.

> There is no demand on the soloist that he or she be a composer, or able to produce new scores. But it is paramount that the soloist be so directly acquainted with the score that he or she is able to offer us a personal interpretation of it; in a sense, a critical commentary on it. Indeed, being a composer may even be a drawback; for it might lessen the critical distance that the soloist needs to maintain in order to bring a fresh interpretation to bear.
>
> (Barnett, ibid.: 631)

A soloist does not have to be a great composer in order to present a wonderful piece. This also applies to sports. If only people who are moving frontiers are able to give good teaching, then there would be no one who can give guidance to a world top tennis player. Hence, Barnett goes on to argue that, a teacher does not have to be involved in actually moving the frontier in order to give good teaching. "One can reach a frontier without crossing it." (ibid.: 630)

The third line of reasoning is the recognition of scholarship of teaching. The traditional but dominant conception of scholarship has been narrowly defined as research leading to publication. (Boyer, 1990: 2; Metzler, 1994 in Brown, 1997: 40) From the traditional view, the term of scholarship is only referred to as research,

especially what Ball called the "Type 3 research" (Ball, 1989: 211), rather than teaching. (Elton, 1992) The assumptions underlying this dominant professorial image are as follows:

1. Research is the central professional endeavour and the focus of academic life.
2. Quality in the profession is maintained by peer review and professional autonomy.
3. Knowledge is pursued for its own sake.
4. The pursuit of knowledge is best organised according to discipline (i.e. according to discipline-based departments).
5. Reputations are established through national and international professional associations.
6. The distinctive task of the academic professional is the pursuit of cognitive truth.
7. Professional rewards and mobility accrue to those who persistently accentuate their specialisations.

(Rice, 1992: 119)

This view alone is legitimate itself in terms of knowledge. However, it is questioned by its professoriate application because it can create tensions among academic activities. One of the destructive effects is that it makes teaching "a derivative activity." (Rice, ibid.: 118) It is "counterproductive" (ibid.: 120) and "cannot help but have a negative impact on students." (Boyer, op. cit.: 2)

A broader vision of 'What it means to be a scholar' is outlined by Ernest Boyer in Scholarship Reconsidered (1990). He distinguishes four types of scholarship: the scholarship of discovery, integration, application and teaching. The scholarship of discovery refers to "the commitment to knowledge for its own sake, to freedom of inquiry and to following, in a disciplined fashion, an investigation wherever it may lead." (ibid.: 17) Next, the scholarship of integration acknowledges scholars' efforts in giving "meaning to isolated facts, putting them in perspective." (ibid.: 18) The third element, the scholarship of application is concerned with the questions such as "'How can knowledge be responsibly applied to consequential problems? How can it be helpful to individuals as well as institutions?' And further, 'Can social problems *themselves* define an agenda for scholarly investigation?'" (original italics, ibid.: 21) In other words, scholarship "has to prove its worth not on its own terms but by service to the nation and the world." (Handlin, 1986: 31 in Boyer, ibid.: 23)

The fourth form is scholarship of teaching. Good teaching is involved with both intellectual engagement and the dynamic efforts to bridge any gaps between a teacher's understanding and the students' learning. (Boyer, ibid.: 23-24) It is argued that "quality teaching requires substantive scholarship that builds on, but is distinct from original research, and that this scholarly effort needs to be recognised and rewarded." (Rice, op. cit.: 125) What makes a teacher-scholar different from a researcher-scholar is manifested in many aspects. For example, Andresen points out that in contrast to researcher-scholars, teacher-scholars are characteristic of their intellectual caring for the other person and their "mediating role" between knowledge and students. (2000: 25) As Terry Smyth put it, "we need to care for our subject ... (but) we should only do this in the context of care for our students, colleagues, ourselves ... the common thread here is ... 'helping the other grow'" (in Andresen, ibid.: 26) It is this "non-reciprocal moral obligation to their students' welfare as learners in addition to an interest in their own personal welfare as intellectuals" that marks a teacher-scholar. (ibid.: 25)

Boyer's proposal is an acknowledgement of the values of *different ways* that keeps academics "throughout their professional careers, stay in touch with developments in their fields and remain professionally alive." (op. cit.: 27) "It is unrealistic, we believe, to expect *all* faculty members, regardless of their interests, to engage in research and to publish on a regular timetable. For most scholars, creativity simply doesn't work that way." (ibid.) The essence of Boyer's idea consists in the concept of equity. All the four types of scholarship are different, but are equally important and should be equally rewarded and celebrated. "The good researcher can achieve success by caring intensely for the subject matter and for the personal investigative discipline requisite to advancing it with integrity. The good teacher succeeds through a *different* relationship to subject matter." (original italics, Andresen, op. cit.: 26)

The fourth argument of the Neutral relationship model is that the assertion of the Complementary model that research and research education are positively connected oversimplifies the diversity and complexity of the research education at the individual level. If that claim is contextualised into a wider context of research education, it is obvious that it fails to take into consideration other factors which can be more important and crucial for doctoral students. It also fails to consider the multiplicity of

the problems and needs which doctoral students confront at this level. Table 2-4 (see Appendix 14) presents the multiple-realities of doctoral education. It summarises the important issues of research education so far arising from the literature at the individual level. At least four dimensions can be recognised: Relationship, Knowledge, Communication/access and Empowerment concerned. The important factors and problems/difficulties of each dimension are both presented in the table.

Table 2-4 (Appendix 14) demonstrates firstly that among the four dimensions, the knowledge of the supervisor is only one of them. All the other dimensions such as Supervisor-student relationship, Communication/access, Empowerment, Problems and difficulties facing research students, are overlooked in the arguments of the Complementary relationship model.

Secondly, even in the dimension of Knowledge, the position taken by the Complementary relationship model is arguable. In the area of knowledge, at least eight topics emerge: (1) issue of ownership, (2) choice of topic, (3) applied nature of research, (4) importance of fieldwork, (5) assisting students in defining and developing their ideas, (6) supervisor's knowledge, (7) ensuring success of research programme and (8) sensitivity to different approaches to knowledge. The arguments of the Complementary relationship model only identifies the seventh point, supervisor's knowledge, and at most the eighth point, sensitivity to different approaches to knowledge. It overlooks the remaining six aspects of knowledge which play an important role in serving the educational function in students' learning, especially in aspects such as, assisting students in defining and developing their ideas, applied nature of research and ensuring success of research programme.

Consequently, the complexity of the research education raises a serious problem in the Complementary relationship model: can the subject knowledge alone be enough to certify a successful researcher to be a good supervisor for doctoral students? Can the subject knowledge alone be enough to solve students' problems and needs faced in their learning process? It is therefore unsound to have arguments for the good supervisor based only on the research productivity of the academics, let alone the doubt of how much the research productivity can equate to the subject knowledge.

For the above reasons, the Neutral relationship model at the individual level of doctoral education argues that it is difficult for research and teaching to enhance each other in doctoral education. It is constrained by three major factors. The first factor is the constraint of time and energy. The second is that in addition to being a researcher there are other significant roles required by a supervisor to play in students' learning. Most importantly, the research knowledge of supervisors alone cannot respond to the complexity of a doctoral education.

Following this logic, a researcher and a supervisor are perceived to be different roles in the Neutral relationship model. In saying that the experience of good supervisors is not necessarily related to their research performance, the Neutral relationship model does not mean to reject the possibility of finding an individual case of an academic who is good at both, bearing in mind that it is unknown about how long an academic can uphold the excellence in both roles prior to burnout (Machell, 1991; Capel, 1992; Emmel, 1993; Blix et al., 1994; Formanuik, 1995; Harden, 1999; de Weert, 2001).

The final point is related to the experience of those academics who are either good researchers or good teachers. The first example is an excellent researcher, Richard Feynman. A "verdict" of the famous introductory course given by Richard Feynman, who was an outstanding scholar in physics, is quoted by Elton. (2001: 51-52) It is believed that his introductory course "undoubtedly provided an integration of research and teaching through deep scholarship". (ibid.)

> Through the distant veil of memory, many of the students and faculty attending the lectures have said that having two years of physics with Feynman was the experience of a life time. But that's not how it seemed at the time. Many of the students dreaded the class, and as the course wore on, attendance by the registered students dropped alarmingly. But at the same time, more and more faculty and graduate students started attending ... Even when he thought he was explaining things lucidly to freshmen or sophomores, it was not really they who were able to benefit most from what he was doing. It was his peers – scientists, physicists and professors – who would be the main beneficiaries of his magnificent achievement.
>
> (Goldstein & Neugebauer, 1995 quoted in Elton, 2001: 51-52)

Feynman's own reflection seems to coincide with the "verdict".

> When I look at the way the majority of the students handled the problems on the examinations, I think that the system is a failure. Of course, my

> friends point out to me that there were one or two dozen students who – very surprisingly – understood almost everything in all of the lectures. These people have now, I believe, a first rate background in physics – and they are after all, the ones I was trying to get at. But then, 'the power of instruction is seldom of much efficacy except in those happy dispositions where it is almost superfluous' (Gibbon)
>
> (Feynman, 1963 preface quoted in Elton, 2001: 52)

The second example is an excellent teacher, Harold Eastman. McGee (1984), who won an award by the American Sociological Association as "a Fighter, a Giver, a Producer and a Master Teacher" for the year of 1984, shares his experience of those people who in a real sense made his life possible over these years. One of them is called Harold Eastman. According to McGee, Eastman was so devoted to sociology that his enthusiasm and his longing for doing the subject were moving. McGee received his first lesson on sociology from him. Eastman is greatly concerned about his students. He kept contact with McGee, even when McGee withdrew from the school to attend another course. Throughout McGee's service, he received letters from Eastman full of encouragement and advice. However, Professor Eastman was not very productive in terms of publications. His works hardly appear in the prestigious journals in sociology, such as American Sociological Review. He was barely known in the discipline. Nevertheless, as McGee put it, "Eastman will die unsung by the discipline, but he was a teacher and should be celebrated." (ibid.) Eastman had such a great influence on McGee that he vowed to dedicate his gratitude to him and many other great teachers in his life.

Everyone from the viewpoint of the Neutral relationship theory can recall some inspiring teachers in college. Those teachers share one similar thing that they all have great influence on our lives in college and beyond. The point that the theorists in the Neutral relationship model try to make here is that those teachers who greatly inspire students are not always active researchers. Feynman as a great researcher and as a great learner himself in the field of Physics did not automatically make him a great teacher in an educational sense. Failing to recognise the various ways of learning and different motivations that learners might hold, even the most successful researcher may fail to be a good teacher.

Moreover, the great and positive experience or influence that are brought upon us from good teachers who themselves may be active or inactive researchers, are hardly to do with their research performance. It may be true for some people to argue that the intellectual vitality brought by active researchers is important because it stimulates a number of students who have potential to pursue research in the future. (Robbins Report, 1963) But if this is the case, how can the argument defend itself when education is supposed to be for all, as argued by Ortega y Gasset? (cited in Smith, 1990) Is it fair for the other students (actually the majority of them) who are not going to pursue research? Presumably that is why, at the individual level, Terenzini and Pascarella (1994) found that "the good teachers are good researchers" is presently one of the "myths" in higher education. For the above reasons, a teacher is not dependent on a researcher and vice versa. It is difficult to find the 'necessary conceptual link' between the two.

2.3 Aggregate Perspective

The relationship between research and teaching can also be explored at the departmental or institutional level. From this perspective, three main arguments supporting a complementary relationship between research and teaching, three supporting a competitive relationship and three supporting a neutral relationship are discussed. They are summarised in Table 2-5.

Table 2-5: Relationship between Research and Teaching from the Aggregate Perspective

Complementary Relationship	Competitive Relationship	Neutral Relationship
Research and teaching are positively related because:	**Research and teaching are negatively related because:**	**Research and teaching are not related because:**
• It is obvious that there is an inseparable link; (Horlock, 1991; Ehrlich & Frey, 1995; Hattie & Marsh, 1996: 511)	• Research and higher education (defined as teaching and learning) are two contrasting activities; (Barnett, 1992)	• Research is not the core of university; (Newman, 1960; Allen, 1988: 18)
• Research is a distinguishing character of higher education; (Scott, 1991; Brown & McCartney, 1998; Flexner, 1930; Jaspers, 1960; Brook, 1965; Ehrlich & Frey, 1995; Furedi, 1998: 137; Johnston, 1996: 161-162; Barnett, 2000: 79, 162-163)	a. Research and teaching are distinctively different in their cultures and social structures. (Baker, 1986)	• Disparity in research drift and teaching drift; (Clark, 1991: 104-105; Clark, 1993: 359-361; Clark, 1995: 193, 196-200, 202)
• Research is a prime factor for an academic milieu.	• Passion for research does not guarantee passion for teaching; (Elton, 2000: 258; Norman, 1999)	• The research performance of the department alone can not respond to the complexity of research education at the aggregate level; (see Table 2-7)
a. Active departmental research is a necessary and exclusive factor for a research environment – a rich intellectual climate; (Rowland, 1996: 10; Robbins Report, 1963: para 555; Neumann, 1992; Hughes & Tight, 1995; Harris Report, 1996: 56)	• Disparity between staff's and students' research environments. (Becher, 1994; Barnett, 1992)	a. Important factors and needs of PhD students at the aggregate level do not always coincide with the departmental research performance. (see Table 2-7)
b. Active departmental research is the major factor in providing good research facilities for doctoral students. (Neumann, 1992)		

2.3.1 Complementary Relationship

The arguments as to why research and teaching are positively related at the aggregate level can be categorised into three main groups: firstly, because of the 'obviousness' of the inseparable link; secondly, because research is a distinguishing character of higher education, and thirdly because research is a prime factor for academic milieu.

To begin with, the idea that research plays a very important role in higher education such that they are closely linked has been 'taken for granted' by some people (Horlock, 1991; Ehrlich & Frey, 1995). They reason that there is an inseparable connection between the two because it is "obvious" or "conventional wisdom". (Hattie & Marsh, 1996: 511) This common belief of the complementary link is manifested mainly in the contribution of university research such as in national emergency, national economy and industrial development. For example, Horlock (op. cit.) highlights the significant role played by university research at times of national emergency using the example of World War II.

The second argument of the complementary link between the two, which is often heard, is that research is a distinguishing characteristic of university education. The first rationale for this idea is autonomy in the pursuit of knowledge. (Scott, 1991; Brown & McCartney, 1998) This has been argued by Flexner (1930), Jaspers (1960), Brook (1965) and Ehrlich and Frey (1995). For example, "the most important defining feature of higher education is the close relationship between the working out of ideas and learning. Without this relationship, higher education ceases to have any distinct role to play." (Furedi, 1998: 137) University in their opinion, has a key responsibility for the advancement of knowledge. It is a place for independent thinking, challenging old assumptions and making new advances. Therefore, universities should be research-oriented:

> For many of us, teaching and research are inextricably linked in a university context: you can't have one (teaching) without the other [research], and where the latter is absent then the institution does not fit the standard definition of a university as an institution in which knowledge is stored, created and disseminated.
>
> (Johnston, 1996: 161-162)

The second and more important rationale for this is that "knowledge is uncertain, relative and provisional" (Ramsden & Moses, 1992: 274) at this level of study. Hence all staff, the argument runs, need to work in a research environment and teaching is enhanced in a context of research activity.

In Barnett's recent book, Realising the University in An Age of Supercomplexity (2000), he claims that research and teaching are a "holy alliance". (ibid.: 162) In a "supercomplex world"— by his definition, research is perceived as "the means of promotion of supercomplexity"; on the other hand, teaching as "the management of the human relations of supercomplexity." (ibid.: 79) By "supercomplexity", he meant that

> it is not just an extended or an expanded form of complexity. It is a higher order form of complexity. It is that form of complexity in which our frameworks for understanding the world are themselves problematic. It is that form of challenge in which our strategies for handling complexity itself are in question. It is a higher order complexity in which we have to find ways of living and even prospering, if we can, in a world in which our very frameworks are continually tested and challenged. This supercomplexity is the world in which we all live.
>
> (Barnett, 2000: 76)

Under this concept of supercomplexity, the university is reframed as a place to "generate supercomplexity: that is the task of its research and scholarship" and also to "help us to live with supercomplexity: that is its educational role." (ibid: 79) Therefore, he maintains that "research, as the public production of supercomplexity, is a necessary condition of teaching in higher education. Teaching, as the production of supercomplexity in the student's mind, is the private act corresponding to the public act of enhancing supercomplexity in the wider policy." (ibid.: 162-163)

The idea of a close relationship between research and higher education is also argued from the third viewpoint of the Complementary relationship: research and academic environment. It claims that research is a must for a lively academic milieu for departments and individuals. It is broken down into two points. The first stresses the significant impact of research on the whole department and individual academics. For example, "there was general agreement, especially in the less vocationally orientated departments, that research (rather than teaching) was the prime factor in departmental, as well as individual, advancement." (Rowland, 1996: 10) The

Robbins Report also states that "the presence of work [research] at this level gives intellectual and spiritual vitality to work at all levels in institutions where it is pursued" (1963: para. 555) It is believed that an inspiring and revitalising atmosphere for academics is a direct result of research. (Neumann, 1992)

The second point highlights the importance of research in creating an environment for learners. It is argued that in a research-oriented environment, students will better develop their approaches and attitudes towards knowledge than in a teaching-oriented environment. (Robbins Report, 1963; Neumann, 1992; Hughes & Tight, 1995) Academics who are active in research are believed to be more enthusiastic, keen, curious and lively. By demonstrating their interests, curiosity and commitments in research, these academics create a stimulating and encouraging environment for learners. On the other hand, only by working with these academics in such an environment, can students develop a positive and confident attitude towards acquiring knowledge.

This line of reasoning has strong implications in doctoral education. The idea that research and doctoral education are closely linked goes to the heart of the question: "Do universities need to have some people who are active in research if they are to be able to offer their students a lively intellectual climate?" (Williams, 1984: 13-14) This question can be further argued and developed into two points. The first point contends that staff should be active researchers to provide a rich intellectual climate. For example, the Harris Report (1996) states that:

> There is a strong argument that pgr (postgraduate research) education is likely to be delivered most effectively in the context of a critical mass of research activity.
>
> (para.5.36. p.56)

> In their evidence, many respondents argued that pgr activity can be delivered most effectively where there is already research quality. ...we recommend to HEFCE: that it should limit its provision of funds in its research model in respect of pgr students to departments or comparable units which have achieved a rating of grade 3 or above in the most recent RAE, or which demonstrate the capacity to obtain significant research grants.
>
> (para. 5.37. p. 56)

It is asserted that a critical mass of departmental research activity and its research quality decide the effectiveness of doctoral education. In other words, it is believed that research students are best trained in an environment of a research-productive department.

The other prevailing point postulating the Complementary relationship is that active departmental research is the major factor in providing good research facilities and infrastructure for research students. This view is especially strongly held by physical scientists. (Neumann, 1992) The more productive the departmental research is, the more funding it can attract, which in turn leads to better laboratories, equipment, and supplies for research students. In order to provide better facilities for research students, the department as a whole should be actively engaged in research.

2.3.2 Competitive Relationship

There are three major arguments postulating that research and teaching in higher education are incompatible. The first contends that research is in stark contrast to teaching. Barnett (1992) explores the relationships in six theses. He claims that research and higher education (which he defines as learning and teaching) are two contrasting activities. He begins by arguing that research is more public in its attempt to produce objective knowledge. In contrast, higher education is more private because it concerns what is going on in the mind of the individual learners. He also emphasises that research is more about the outcome because results count for everything, whereas higher education is concerned with the process because learning is a process of self-development. From his perspective, learning is the focus of higher education. However, it is a "by-product" of research because no one is concerned about the personal learning experience of the researcher once the work is published. Furthermore, higher education is more open in having the characteristic of a conversation between learners and the teacher while research is regarded as more closed in highly specialised inquiries. Next, the academic community has a direct relationship with research but has an indirect one with higher education. This is because learners, although important components in higher education, are not counted as full members of the academic community. Finally, according to Barnett, "research

is a necessary but not a sufficient ingredient for higher education". (ibid.: 627) Not every piece of research has an application in extending the students' understanding and teaching, but some of them occasionally do. Therefore, according to this analysis, research can hardly ensure good teaching.

In a similar vein, Baker (1986) points out the dissimilarity between the research and teaching cultures. He analyses the diversities in both cultures and social structure developed by research and teaching with an example from sociology. The key contrasts are summarised in the following Table 2-6, which is a reproduction of Baker's Figure 2. (ibid.: 55)

From Baker's perspective, research and teaching are diverse in two dimensions: culture and social structure. To begin with, the research and teaching cultures are two disparate worlds. The teaching culture is client-centred (ibid. 54) emphasising the process and human interaction between staff and students. It concerns the learning progress and feedback from students. What fills a teaching context is an atmosphere of consideration. In contrast, research culture is knowledge-centred focusing on specialised information, ideas and feedback from colleagues who share the same interests. The debates, arguments and evidence around the topic are the main concerns. What fills a research context is an atmosphere of thoughtfulness.

Baker further points out that the two cultures are diverse along three lines: societal mandate, technical culture and institutional values. The societal mandate of research culture is to create new knowledge for equally informed colleagues. (ibid.) The completion of research projects or publications is the top priority. Because of the severe competition in the fields, what concerns researchers is not only the quality of the publications, but also the quantity and volume. In contrast, the teaching culture aims to transmit knowledge to less informed students. The student is the top priority. How to better support learners and to facilitate better learning are the main concerns.

Baker (ibid.) also accentuates the dissimilarities of the technical cultures of research and teaching. The technical knowledge, great dedication to advance it and the mastering of the terminology in the knowledge for younger researchers are highlighted in research culture. In contrast, there is no requirement of dedication to

Table 2-6: Two Dimensions of Professors' Roles of Teaching and Research: Points of Divergence (Baker's Figure 2, 1986: 55, my bold)

I. Research	II. Teaching
A. Culture	**A. Culture**
1. Societal mandate: Produce new knowledge for equally informed colleagues. **2. Extensive and rigorous technical culture** a) Technical knowledge considered imperative for all scientists. b) Strong value commitment to continue development of a shared technical culture. c) Elaborate codification of knowledge that must be mastered by beginners. **3. Four institutional imperatives** a) **Univeralism**: Truth claims depend on pre-established impersonal criteria. b) **Communism**: Research findings are product of social collaboration and are assigned to the total community. c) **Disinterestedness**: Demands of objectivity deny any place for personal motives or special interests. d) **Organised skepticism**: Temporary suspension of judgement until empirical and logical criteria are scrutinised.	1. **Societal mandate**: Transmit existing knowledge to less informed students. **2. Little or no technical culture** a) Common-sense knowledge considered sufficient by most teachers. b) No value commitment to build a shared technical culture. c) No widely accepted codification of minimal knowledge for beginning teachers. **3. Four institutional indulgences** a) **Particularism**: Truth claims about teaching skills often depend on personal and social attributes. b) **Privatism**: Each professor is on his/her own, creating private satisfaction or dissatisfaction. c) **Personalism**: Demands of objectivity are often compromised by personal loyalties and uncontrolled biases. d) **Aggregated dogmatism**: Each professor adheres to favourite theories of students, learning, academic goals, testing procedures, etc.
B. Social structure	**B. Social structure**
1. Collegial system of collaboration and criticism a) Active local and cosmopolitan network of colleagues. b) Gradual induction into work through mentors and peers. **2. Elaborate system of sanctions** a) Systematic gatekeeping that referees researcher's work. b) Many mechanisms to assure that outstanding work earns public rewards. **3. Career line open to advancement** a) Researcher assumes greater challenges with increased skills and public recognition. b) Research achievements are considered in negotiations for better opportunities – system of publishing and prospering.	**1. Cellular system of social isolation** a) No local or cosmopolitan network of colleagues. b) No system to assure that outstanding work is rewarded. **2. Limited system of sanctions** a) No gatekeeping mechanisms that distinguish excellent and mediocre efforts. b) No system to assure that outstanding work is rewarded. **3. Career line truncated** a) Teacher is doing same thing at the end of the career as at the beginning. b) Teaching achievements (local work) cannot be considered in negotiations for better opportunities – system of teaching and perishing.

build a shared technical culture and of codification of minimal knowledge for younger teachers in teaching culture. (ibid.)

Furthermore, the diverse characteristics of these two cultures at the institutional level are examined. (Baker, ibid.) The teaching and research cultures are compared along four dimensions. The first is 'particularism versus universalism'. That is, skills in the teaching culture are more reliant on personal and social factors rather than impersonal criteria as in the research culture. The second is 'privatism versus communism', meaning that teaching is a private process, whereas research findings are shared in a community. In the third case 'personalism versus disinterestedness', objectivity, in Baker's opinion, can be compromised in the teaching culture, whereas it is demanded in the research culture. The fourth dimension is 'aggregated dogmatism versus organised scepticism'. In the teaching culture, teachers can make the personal judgement along the whole process of teaching. In contrast, researchers can only make this kind of judgement after they have evidence.

The second dissimilarity between research and teaching consists in the distinct social structures that construe the two roles. It is developed into three points: collegial system, system of sanctions and career line. (Baker, ibid.) Baker begins by indicating that collegial system is collaborative and critical in the social structure of research. It is characteristic of its "active local and cosmopolitan network of colleagues" and "gradual induction into work through with mentors and peers". (ibid.: 55) In contrast, the social structure of teaching is neither constructed by local or cosmopolitan network nor having gradual induction into work. It is characteristic of its "cellular system of social isolation". (ibid.)

Next, Baker discovers that the system of sanctions is fully developed in the social structure of research, whereas it is limited in the teaching structure. For example, there is "systematic gatekeeping" for research, and many rewarding mechanisms for good work. But there are "no gatekeeping mechanisms that distinguish excellent and mediocre efforts" in teaching and no system to ensure that good teaching is rewarded. (ibid.)

This leads to the third point which is concerned with the "career line". (ibid.) Baker notes that the career line is open to advancement in the social structure of research where the "researcher assumes greater challenges with increased skills and public recognition". (ibid.) Research achievements are taken into account for better career positions by publications. However, the career line is "truncated" in the social structure of teaching. For example, a teacher is doing similar things throughout his/her career. Teaching achievements are difficult to negotiate for a better career position. (ibid.)

Due to above reasons, Baker concludes that "given the sharp contrasts between teaching and research, it is hardly surprising that a stable dyad is difficult to articulate." (op. cit.: 54) Universities from this point of view do not have to be active in research in order to provide the best education for students. "While more recent research has demonstrated the potential value of staff research to student learning, it does not follow that all staff need to be 'research active' or that all departments need to focus on discipline-based research." (Jenkins, 2000: 344)

This leads to the second argument. In an attempt to flesh out a proposal of this sort, Elton (2000) reasons that passion / love for research and for teaching are different. It is believed that not all researchers are *interested* in teaching. A love or passion for research does not guarantee the same for teaching and vice versa. "Academics normally do not love all of their subject equally. They tend to love most what they research into." (Elton, ibid.: 258) Those academics who are passionate in only one role are likely to treat the other as a daily chore. Unfortunately, there are those who are interested in neither.

The Competitive relationship model also reasons that passions for research and for teaching are different in that love is one thing and expressing that love is quite another. Researchers "may not be very good at conveying the love which drives them since they may not be very good lovers or – to put it in context, they may not be very good teachers." (Elton, ibid.) This is probably why "even those professors who care about teaching know little about the art." (Norman, 1999 in Elton, ibid.)

Moreover, love for a person and love for an idea are not the same thing. The word 'teaching', in contrast to 'research', has two objects: "I do not only teach a subject, I do not only teach students; I teach students a subject." (Elton, ibid.) A good teacher has love for the subject and most importantly, love for students. Due to the love of students, teachers facilitate, profess, share their love of subject with students and take students' learning as their personal responsibility. Love of a subject alone is neither enough nor incommensurable with the love of students.

Therefore, for a supercomplex world claimed in the Complementary relationship model to work, academics who have equal passions or love for both research and teaching are needed. The question then becomes: how many academics have equal passion or love for both roles? Of course, there is no quick answer to this. Only by glimpsing at this question from the perspective of the Neutral relationship, it seems that quite a few people in *this* earthly world would not be qualified – because academics unlike supermen or God are human beings and therefore have human preferences.

The third argument postulating a Competitive relationship accentuates the disparity between staff-research environment and student-research environment. It is argued in the Complementary theory that an environment of a critical mass of research activity created by the staff is also a rich environment for doctoral students. However, the Competitive relationship model disagrees with the assumption underlying the Complementary model that staff and research students share the same research environment and therefore, a research environment for staff is also an appropriate research environment for students. Instead, the Competitive relationship model asks: do staff and students share the same research environment? How do we know that a rich research environment for staff means the same thing for students? How much can research students benefit from a staff-centred research environment? Is there any difference between the staff-centred research environment and a research learning environment for students?

It is then argued by the Competitive model that it may be true in some scientific subjects where research students' projects are part of their supervisors' programmes and both of them share the same laboratories. (Becher, 1994) Even though, the

facilities for experiments and resources that the research students in sciences can benefit from are more at the individual level rather than at the departmental level. For social sciences and humanities, students are not so fortunate. Most students and their supervisors in social sciences and humanities have their own projects and work individually. They are less likely to share resources. If this is the case, then it would be inappropriate to argue that a rich research environment for staff means the same thing for students.

Next, research students are also usually not regarded as full members of academic community. (Barnett, 1992) Even in a situation where research climate is lively it is still difficult for research students to be intellectually involved with the research activities among staff unless they are invited to do so. Consequently, from a perspective of the Competitive model, it would be more sensible for the Harris Report to state that:

1) Postgraduate research education is likely to be delivered most effectively in the context of a critical mass of ***research students'*** research activity, and
2) Postgraduate research activity can be delivered most effectively where there is already research quality in ***research students'*** output.

This line of reasoning generalises: the right setting for research does not mean the same for teaching. It challenges the concept of the Complementary relationship model that research is the only way to create an inspiring environment that will benefit all in universities.

2.3.3 Neutral Relationship

Three major arguments are found as to why research and teaching in higher education are expected to be unrelated. The first posits that research is not what university stands for. Perhaps, it is true that the majority of universities claimed by theorists of the Complementarity model, conduct plenty of useful research and try to produce a research-focused environment for all academics. However, this does not mean that the assumptions underlying the contention that research is the distinguishing characteristic of a university education should be accepted uncritically. Instead, the Neutral relationship model maintains that the main objective of the university is to educate the younger generations as asserted by Cardinal Newman (1960) in 1852. The central part of higher education is about students, learning and teaching. For this reason, research will be best carried out in separate institutions owing to the possibility of its interfering with learning and teaching. In fact, Newman doubts, if research is the primary aim of the university, what are students there for?

> The view taken of the University in these Discourses is the following: - That it is a place of teaching universal knowledge. This implies that its object is, on the one hand, intellectual, not moral; and, on the other, that it is the diffusion and extension of knowledge rather than the advancement. If its object were scientific and philosophical discovery, I do not see why a University should have students; if religious training, I do not see how it can be the seat of literature and science.
>
> (1960:xxxxvii, 1852 first edition.)

Newman is dubious about university research. He contends that research and teaching are not mutually beneficial and should be separated. This view is echoed by Ortega y Gasset in his book, Missions of the University. (Allen, 1988: 18)

The second argument is related to the three common trends in international higher education, named as "forces of fragmentation" by Clark (1991, 1993, 1995), that enforce the separation of research and teaching. They are: (1) mass higher education, (2) research drift and (3) teaching drift. To begin with, in response to labour force demands, the number of students entering higher education have rapidly increased for the past two decades. (Clark, 1991, 1993) In order to cope with students from various educational backgrounds, introductory teachings are intensively required. "Entering students are not at a level of sophistication in a given knowledge domain where by immersion in research, or direct training for research, is seen as appropriate." (Clark,

1991: 104-105) The teaching style has to shift from more intimate personal relationship to more "formal, wholesale arrangements that can accommodate much larger numbers of students and students more varied in background." (Clark, 1993: 359) Two classes of academics thereby are created: the university lecturer defined as "full-time teaching with no research involvement" and the professors as "traditionally understood – are expected to do research and are granted appropriate conditions of time and resources." (Clark, 1991: 105) As a consequence, "the expansion of knowledge at the hands of research creates research settings that leave teaching and study behind." (Clark, 1993: 361)

Clark also points out the "research drift" caused by knowledge expansion. (Clark, 1993, 1995) The development of knowledge has generated enormous growth in disciplines and academic departments. (Clark, 1993: 360) "The 'high knowledge' components of higher education systems, spurred by the drive for new knowledge, steadily become more esoteric." (ibid.) The "intense, diverse, and esoteric" knowledge constitutes a "research imperative" environment where research resources, research infrastructure and research-related personnel are perforce concentrated. (Clark, 1995: 193) The research imperative "needs its own modes and lines of support that are unfettered by the complexities of the channels that support the educational dimension of universities." (ibid.: 196) Academics are required to be "deeply dedicated to research." (ibid.) However, "a commitment to full-time pursuit of research can be tantamount to a decision to leave to someone else the tasks of teaching and the provision of places for training." (ibid.: 197) Therefore "it becomes difficult, if not impossible, to develop and maintain all these needed concentrations in the traditional locales of teaching and study." (Clark, 1993: 961)

On the other hand, the "teaching drift" is highlighted. (Clark, 1995: 197-200) Three reasons argued by Clark make teaching drift away from research: (a) it is the development of pure teaching institutions, which "deliberately set apart from ones that are research centred" (ibid.: 197); (b) it is the enormous need for introductory teaching due to mass higher education; (c) it is the growth of the "nonresearch tracks for students at advanced levels" such as the "terminal master's degree" and "professional degree programmes". (Clark, 1991: 105, 1995: 199) As a result, "much

more teaching is needed which does not have to be intimately blended with research activity or serve significantly as training for research." (ibid., 1995: 202)

The above three common trends act most directly on the teaching-and-learning components to encourage a divorce from research and vice versa. Consequently, from the perspective of the Neutral relationship theory, the equity between research and teaching in either the complementary relationship model or the idealism of supercomplexity is one thing; the reality of dissimilarity between the two is quite another.

The third line of reasoning in the Neutral relationship model postulates that the positive relationship claimed by the Complementary model fails to recognise the complexity of research education at the aggregate level. Table 2-7 (see Appendix 15) reveals the multiple-realities of doctoral education in matters of essential concerns and difficulties. It summarises the important issues of research education arising from the literature at the aggregate level. They can be categorised into four dimensions: Institutional structure, Research training, Research environment and Research culture. In Research culture, the main points can be classified into four areas: Research-concerned, Access-concerned, Atmosphere-concerned and Interaction-concerned. Both the important factors and problems/ difficulties are presented in each dimension in Table 2-7.

In response to the debate, first of all, Table 2-7 (Appendix 15) shows that it is only in the area of 'research concerned' in the dimension of research culture that the research productivity of the department is highlighted. All the other dimensions, (such as institutional structure, research training and research environment) are dismissed from the arguments in the Complementary model. The Complementary model also ignores other important areas in research culture, such as access-concerned, atmosphere-concerned and interaction-concerned. From the perspective of the Neutral relationship model, the Complementary view that stresses only one aspect of the complexity of research education, which is staff research, can be partial.

Secondly, if we narrow down the discussion only to the area of research in the dimension of research culture, the stance taken by the Complementary Model is still

debatable. In the area of research, at least three issues emerge: the coherence and integration of the departmental research, the critical mass of research, and pedagogic continuity. The arguments in the Complementary model only identify the second point, the critical mass of research. It fails to recognise other facets of research, which are important in serving the educational function in the doctoral education, such as the coherence and integration of the departmental research and its pedagogic continuity. Moreover, this also raises another question: will the emphasis of research productivity of academic staff go smoothly with the others? This is why Barnett (1992) doubts whether the education facet of PhD study could really survive in the current context of one-dimensional emphasis on staff research.

Therefore, to summarise, the Neutral relationship theory argues that staff and students may not share the same research environment. A research environment which is rich for staff may not mean the same thing for students. Furthermore, the importance and needs of research students do not always coincide with the departmental research interests. Hence, the research performance of the department alone cannot respond to the multiple dimensions of doctoral education.

2.4 Comments on the Three Types of the Relationship

Each of the above three models, Complementary, Competitive and Neutral relationship, has its limitations. For example, in response to the Competitive relationship theory, although it is true that a person's time and energy is limited, there is controversy as to how time and energy spent on teaching relates to teaching effectiveness. Fairweather's analysis of how academics spend their time in relation to their teaching, research, administrative and other activities in different types of universities in 1987-88 in the United States shows that despite the different types of universities, academics who spend less time on teaching devote more time to research (1996: 27). It is also found that in terms of "student contact hours", professors have "the least amount of student contact on average, associate professors the most, and assistant professors in between the two." (ibid.: 38) However, it is found that at the institutional level, "faculty in research and doctoral-rating institutions did spend less time in class per week, but they generated as many student contact hours as their peers

in master's-level institutions." (ibid.: 38) In addition, it is uncertain whether research time and teaching time is commensurable. It is asked whether an hour of doing research is equal to an hour of teaching? (Hattie & Marsh, 1996: 509) It is evidently an area that needs further investigation.

There is one point from a historical perspective, which is worth discussing and can shed some light on the arguments in the Neutral Relationship theory. It is a response to the concepts of creativity and discovery in scholarship from the theorists in the eighteenth century. Since the Humboldtian era in the nineteenth century, professorial creativity, discovery and research have been assumed to mean the same thing. They are so closely related that they could almost exchange one for the other These three concepts constituted nearly the only form of scholarship. (Turner, 1975: 525)

Nevertheless, theorists in the eighteenth century disagreed with this conception. Firstly, they disapproved of equating professorial creativity with professorial discovery. In their opinion, professorial creativity is something more than discovery. It incorporates a wider range of scholarly activities. (ibid.) Next, they disagreed with equating publication and discovery. Not all professorial publications automatically embody professorial discovery. (ibid.) They believed that the professorial discovery is not related to his writing activity. They also disapproved of equating discovery and research. They asserted that the results of research do not necessarily lead to academic discovery. Except by chance, discovery is perceived as something which can only be derived from extraordinary intelligence and a penetrating mind; namely, a genius. (ibid.: 526) The last but the most important point is that they disapproved of incorporating discovery as an obligatory element of scholarship. In addition to the above reasons, they contended that discovery will divert efforts from teaching which is perceived as the first responsibility of professors. They did not believe that a person can be a successful discoverer and an effective teacher at the same time, because these two roles are both psychologically and intellectually very different from each other. (ibid.) For the above reasons, they claimed that "discovery could not and should not be a duty of the university." (ibid.: 526)

On the other hand, the arguments in the Complementary relationship model can be examined from submission rate and historical perspective. If the complementary

argument is right, then the more productive the research environment is, the better submission rate research students have. Is this the case? The Universities of Oxford and Cambridge have been recognised as the most prestigious universities in terms of their research performances in the UK. Presumably they have the best-possible research environments in the campus. However, the University of Cambridge has been once found on a "blacklist of institutions where ESRC [Economic and Social Research Council] studentships can no longer be held because fewer than 40 percent of Cambridge's PhD students have managed to complete their degree in the prescribed four-year period" (Heron, 1989:1; see also Becher et al., 1994: 28). According to Becher, Henkel and Kogan (1994), unsatisfactory experiences of postgraduate students were mainly found in the most prestigious institutions or in the context of intensive competition among academics. They then reason that "the Humboldtian ideal of research as a common pursuit of knowledge between teachers and students to their mutual enhancement was not necessarily realised in practice." (ibid.: 150)

Next, it is concerned with the contemporary and the Humboldtian conceptualisations of the complementary relationship between research and teaching. Nowadays when people discuss the original idea of the modern university, they will not fail to refer to the University of Berlin and the Humboldtian era. Although the view that research and teaching enhance each other is shared among theorists both in the Humboldtian times and in the Complementary relationship theory. However, do they really talk about the same thing?

In the Humboldt era, the idea of the mutual enhancement of research and teaching involves both teachers and students. Humboldt and Fichte introduced not only the research function of a university but also a new pedagogy. Compared with the old, dogmatic one, the new pedagogy stressed a dialectical relationship between professors and students. For example, a lecture is a time when the professor shares his/her loose first reading, which is followed or interrupted by positive or critical comments from students. "The university lecture, then, would resemble in some ways a serious-minded soirée in a Berlin salon." (McClelland, 1980: 124) Therefore, the university becomes a place where "both teachers and students could 'devote themselves to science' (der Wissenschaft leben)", in Humboldt's term. (ibid.: 125) In other words,

while Humboldt and other Humboldtians claimed the research orientation or the mutual enhancement of research and teaching, the research here actually and exclusively refers to the joint endeavours both from professors and students under a certain way of teaching. It is in this sense that research and teaching really fuse together.

Modern theorists who advocate the mutual enhancement of research and teaching seem to refer to something slightly different. In contrast to the Humboldtians, the issue of the mutual enhancement of research and teaching is tackled in a way as if it is only related to scholars. It assumes that these two scholarly activities are endeavours of and only of academic staff, especially research activity. In other words, the meaning of a research-oriented university has changed. In the early nineteenth century, it meant a place both for staff and students to jointly enquire into the new knowledge, while in the modern times, it more implies a place for staff to carry out their own research. More importantly, when modern theorists claim the positive relationship between research and teaching, they fail to identify what kind of teaching or pedagogy and what kind of research they are talking about. How many teaching styles could we possibly identify? How many types of research could we distinguish? Do they all enhance each other, in any case, any way? Unfortunately few modern theorists in the Complementary model can give details about the process of the mutual enhancement of research and teaching, and in what way and in what form they are enhanced.

This chapter has presented a theoretical discussion of the research/teaching debate. The next chapter will examine empirical findings with regard to the relationship between research and teaching.

Chapter Three

Previous Empirical Research Findings

For the past fifty years, much empirical research has been carried out probing the relationship between research and teaching. The ideas have been discussed in the previous chapter, but what kind of evidence is there? The important empirical studies that are examined in this chapter mainly focus on publications of the last ten years. They were collected from electronic databases: ERIC, British Education Index (BEI), BIDS International Bibliography of the Social Sciences and EMBASE. They cover most of the published work in English from UK, Australia, USA, New Zealand, Spain, Denmark, Norway and other countries. It also means that readers need to bear in mind that higher education systems can vary between those countries. These empirical results are firstly investigated at the individual level and secondly at the aggregate level. Both the relationship between research and teaching and the possible disciplinary variations are discussed. Some studies cover the two levels.

3.1 Empirical Findings at Individual Level

At the individual level, thirteen major empirical studies were found for the period 1990-2000. Six of these studies are correlational-based research and seven exploratory-based. In the correlational research, three of the six give correlation coefficients. The authors of the remaining three did not give correlation coefficients. For the statistical purpose of clarification, the empirical findings of the relationships between research and teaching are briefly categorised into three groups: positive, negative and neutral links. A positive relationship, corresponding to the Complementary model generated from conceptual discussion in Chapter Two, indicates that research and teaching are complementary and enhance each other. A negative relationship, corresponding to the Competitive model, means that research and teaching are competitive and in conflict with each other. A neutral statistical relationship result means that research and teaching are not related. Some studies reveal more than one type of relationship. Correlational studies which are

summarised in Table 3-1 and Table 3-2 will be explored first, followed by exploratory empirical studies in Table 3-3.

3.1.1 Correlational Studies at Individual Level

With regard to the relationship between research and teaching at the individual level, it is found that one of the six correlational studies shows a positive relationship (Smeby, 1998 in Table 3-2); one indicates a negative link (Ramsden & Moses, 1992 in Table 3-1); two reveal a result of neutral relationship (Melland, 1996; Noser, Manakyan & Tanner, 1996 in Table 3-1). The remaining two studies do not explicitly identify the type of relationship. Those two focus on disciplinary differences (Moses, 1990 in Table 3-2) and staff perceptions of the link (Martin, 1997 in Table 3-2).

To begin with, the finding of positive link, Smeby (1998) distributed questionnaires to staff of the rank of assistant professor or higher in all four universities in Norway. Staff opinions on the connection between their teaching and research were explored. For example, "the extent to which university faculty thought their teaching at different levels was affected by their research activities and whether teaching at different levels gave positive impulses to their research activities." (ibid.: 8) It is found that "university faculty believe there is interaction between research and teaching." (ibid.: 17) About half of the staff agree that teaching is influenced by their own research to some extent. About one third of them agree that teaching gives positive input to their own research to some extent. The effect of teaching on research is perceived to be less than the other way round.

Unlike Smeby's study, Readers and Professors are deliberately omitted in Martin's research (1997). 49 lecturers in one university were asked to report their perceptions about their research, teaching or balance of both. A contradictory result is found: while "two-thirds (67%) of the respondents were dissatisfied with the present relationship between teaching and research", half of them (51%) think that the present situation brought about some job satisfaction. Martin explains that it is because "research productivity is perceived as having greater career benefit than the quality of teaching and it might be that the high level of satisfaction reported by those who had

a perceived emphasis on research was a result of this same shared culture." (ibid.: 157)

Table 3-1: Correlational Studies with Correlation Coefficient on Research and Teaching at the Individual Level

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Association between Research and Teaching in Australian Higher Education	Ramsden & Moses, 1992	• Questionnaire: about 1,780 full time staff in 18 institutions. Self-rated teaching commitments. • Subjects: Health Sciences; Science, Mathematics & Computing; Engineering; Humanities; Social Sciences; Economics & Commerce; Law. • Country of study: Australia	• Negative (r =-.13; -.14, p<.0001) "There is a clear indication of a negative association: although not all coefficients are statistically significant, every sign is negative." • Disciplinary differences: "The weakest of the association occurs in humanities subjects, and the strongest in the sciences and social science."
Great Researcher …Good Teacher	Melland, 1996	• Questionnaire: 71 staff in 60 nursing faculties on research productivity. • Questionnaire: teaching evaluation from students of 60 staff • Subject: Nurse education • Country of study: US	• Neutral (r =.11, p?) "This indicates little, if any, relationship between the two variables of research productivity and teaching effectiveness." • Disciplinary differences: (not applicable)
Research productivity and Perceived teaching effectiveness: a survey of Economics faculty	Noser, Manakyan & Tanner, 1996	• Questionnaire: 344 professors Self-reported measure of research output. Self-reported scores of student teaching evaluation. • Subject: Economics • Country of study: US	• Neutral (r = -.18~ .24, 'p' varies) "Only a marginal relationship between research activity and teaching effectiveness, with very few cells exhibiting significant correlations." • Disciplinary differences: (not applicable)

r: Pearson's r.
p: p value or significance level.

Table 3-2: Correlational Studies with No Correlation Coefficient Given on Research and Teaching at the Individual Level

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Teaching, Research and Scholarship in Different Disciplines	Moses, 1990	• Questionnaire: 314 senior academic staff and above. Self-report of the link between research and teaching. • Subjects: Chemistry, Engineering, English and Law. • Country of study: Australia	• Disciplinary differences: "Teaching is experienced differently in the different disciplines; in some it may be largely divorced from own research and teaching is enjoyed as such. In others, like English and Law, there is a necessity to align teaching and research interests."
Teachers or Researchers? The perceptions of Professional Role Among University Lecturers	Martin, 1997	• Questionnaire: 49 lecturers in 1 university (intentionally excludes Readers and Professors) Self-report of the link between research and teaching. • Subjects: Engineering, Social Sciences, Natural Sciences. • Country of study: UK	• Research is more valued than teaching. 18% of the respondents think teaching is under valued. "Research productivity is perceived as having greater career benefit than has quality of teaching." • Disciplinary differences: Lecturers in Social Sciences have the strongest view to perceive their roles to be mainly concerned with teaching.
Knowledge Production and Knowledge Transmission. The Interaction between Research and Teaching at Universities	Smeby, 1998	• Questionnaire: faculty members in all 4 Norwegian universities. Self-report of the link between research and teaching. • Subjects: Humanities, Social Sciences, Natural Sciences, Medicine, Technology • Interview: faculty in Physics (Natural Sciences) & Nordic Languages and Literature (Humanities) in 2 universities. • Country of study: Norway	• Positive "University faculty believe there is interaction between research and teaching." • Disciplinary differences: Research and teaching are perceived to be more related in Humanities and Social Sciences at undergraduate level. "The interaction is stronger at a graduate than at an undergraduate level."

However, a negative relationship between research and teaching is found in Ramsden and Moses (1992). The study of Ramsden and Moses covers both the individual and aggregate levels. (Their research findings at the aggregate level will be examined in section 3.2.1.) At the individual level, they analysed questionnaires from 1,780 full-

time staff in 18 institutions in Australia. The staff attitudes towards nine statements concerning their teaching and students were collected. These self-reported attitude scores were then calculated with their self-reported research productivity consisting of the total numbers of publications, and research activity. Research activity refers to eleven items regarding: receiving research grants; supervision of postgraduate students; delivery of conference paper; and research contact with others. The correlation coefficients of the commitment to teaching for the whole sample turn out to be -.14 with research activity and likewise -.13 with research productivity. They found that "there is a clear indication of a negative association: although not all coefficients are statistically significant, every sign is negative." (ibid.: 286)

On the other hand, Melland (1996) and Noser, Manakyan and Tanner (1996) discover a neutral relationship. Melland (ibid.) distributed her Research Productivity Questionnaires (RPQ) to randomly selected 71 staff in 60 nursing faculties in the US. 60 of the 71 staff agreed to send the Teaching Effectiveness Questionnaire (TEQ) to their students. The RPQ includes 15 items assessing staff's research activities such as the publication of journal articles, books, proceedings of a meeting and presentation at conferences. A publication score is calculated for each respondent, where some items are weighted more than the others. Meanwhile one item in the TEQ is used as an indicator for teaching effectiveness in this research: "Overall, how would you rate this instructor?" The rating scale is from 1 (very bad) to 5 (excellent). According to Melland, the Pearson correlation between the publication score and the teaching effectiveness is 0.107. "This indicates little, if any, relationship between the two variables of research productivity and teaching effectiveness." (ibid.: 34)

Similar results are found in Noser, Manakyan and Tanner (1996) The questionnaire which uses self-reported measure of research output and self-reported score of teaching evaluation was sent to 1000 randomly selected professors in US colleges and universities. 344 of them replied. The research output is divided into seven categories. The total annual research score (TARS) and the weighted annual research score (WARS) are calculated. It is found that among seven categories, teaching effectiveness score at the undergraduate level only has a slight positive relationship with category 4 "all other referred economics" (p=.11). All the others are close to zero. It is slightly related to TARS (p=.12) and even less to WARS (p=.09). These

findings demonstrate that "only a marginal relationship between research activity and teaching effectiveness, with very few cells exhibiting significant correlations." (ibid.: 307) It is also found that the overall teaching evaluation score is only slightly positively related to category 7 (p=.14). Its relationships to two overall research success are almost zero: p=.07 with TARS and p=.04 with WARS.

3.1.1.1 Disciplinary Differences

The above correlational studies also show that the relationship between research and teaching can vary between disciplines. Four of the five correlational studies which involve more than one subject area at the individual level highlight the disciplinary differences in the relationship. Ramsden and Moses (op. cit.) find that all the correlation coefficients between teaching and research in the social sciences, arts, science/maths, engineering, commerce/law, and health sciences are negative. Teaching and research are most negatively related in the social sciences and sciences. The least negative link is found in the arts. In another study by Moses (1990), questionnaires from 314 staff with the rank of senior tutor or above at one university in Australia were collected. Staff were asked to indicate their attitudes towards teaching and research. A scale from 1 (very poor) to 7 (outstanding) were provided for staff to assess their own teaching performance. The results reveal that for subjects such as English and Law "there is a necessity to align teaching and research interests" in contrast to Chemistry and Engineering. (ibid.: 373)

Similar result is found in Smeby (op. cit.). He distributed the questionnaires to staff in humanities, social sciences, natural sciences, medicine and technology in four universities in Norway. It indicates that research and teaching are perceived to be more related in humanities and social sciences than in natural sciences and medicine. In contrast to Moses and Smeby's research, Martin (op. cit.) targeted lecturers and senior lecturers in engineering, social sciences and natural sciences in one university. He discovered that lecturers in social sciences have the strongest view that their roles are mainly concerned with teaching.

3.1.1.2 Brief Summary

From the above analysis, it seems that firstly, the majority of correlational studies at the individual level discover either neutral or negative relationships. Secondly, correlational studies with data obtained from students or younger academic staff indicate a stronger negative relationship between research and teaching in the non-sciences than in science subjects: Ramsden and Moses, 1992; Martin, 1997. On the other hand, correlational studies with data obtained from all academic staff or senior staff showed a weaker positive relationship in the sciences than in non-science subjects: Moses, 1990; Smeby, 1998.

3.1.1.3 Comments on Correlational Studies

Most of the above correlational studies are limited in their analysis and samples. The first issue is concerned with the research analysis. With few exceptions (notably, Ramsden & Moses, 1992; Melland, 1996), most correlational studies at the individual level use only staff self-reported scores to measure either their teaching performance or the link between research and teaching. This can have two difficulties. The first one concerns how reliable it is to use staff self-reported scores as a method to measure their own teaching performances. If the staff are asked to evaluate their own teaching as in two of the studies, then the analysis of self-reported teaching effectiveness is confronted with the question: how reflective those staff are on their own teaching performance? If the staff are asked to recall the evaluation score given by students in the last two academic terms as in one of them, it still has to face: how good those staff's memories are. How many staff members can actually remember the exact scores of their students teaching evaluation on each of their course and work out an average score of those scores? Moreover, what the staff believe or perceive about their research/teaching relationship may not be the real situation that happens in the educational settings. It is dangerous to assume that staff perceptions of the relationship between research and teaching really reflect the actual interactions in the classrooms. Further evidence is needed to verify the staff perceptions.

The second issue is related to research samples. With few exceptions (Ramsden & Moses, 1992 and Melland, 1996), the research samples tend to be confined primarily to staff. The student's voice is lacking. Students who are both stakeholders and at the receiving end of the education not only are legitimate subjects to shed light on the debate but also can give triangulated information about what actually happened in the educational settings. Therefore, the scarcity of the student's perspective can weaken the possible patterns that may account for the relationship between research and teaching.

3.1.2 Exploratory Studies at Individual Level

The results of seven exploratory empirical studies reveal uncertain outcomes. (Table 3-3) The majority of them find both positive and negative sides of the relationship. (Jensen, 1988; Jenkins et al., 1998; Serow, 2000; Coate et al., 2001). Some of them indicate more disparities than complementarity in the relationship (Jenkins, 1995; Colbeck, 1998; Robertson & Bond, 2001).

Most of the exploratory studies at the individual level reveal both positive and negative sides of the relationship. In the first instance, Jensen (1988) interviewed 49 staff in 9 departments about the link between research and teaching in Denmark. It is based on a teacher's own assessments of the interrelationship between the two. He found that research and teaching are both negatively and positively related. Research benefits teaching in three ways: (1) "research fertilises teaching with new topics and methodological advances" (ibid.: 20); (2) "research provides teachers with a personal engagement of great pedagogic significance" (ibid.), and (3) "university teaching, via the research carried out by staff, maintains connections with developments in the world of international research" (ibid.). On the other hand, teaching benefits research in two ways: (1) "teaching provides a breadth of practice within the subject outside the narrower field of research, with a positive feedback effect on the research done" (ibid.) and (2) "the annual 'confrontation' with the new intake of students is – despite everything – a stimulating form of pressure." (ibid.) However, the link between the two is asymmetric – "the influence of research on teaching is assessed as being

Table 3-3: Exploratory Studies on Research and Teaching at the Individual Level

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Research and Teaching in the Universities of Denmark: Does Such an Interplay Really Exist?	Jensen, 1988	• Interview: 49 staff Self-report of the link between research and teaching. • Subjects: Chemistry, Economics and French. • Country of study: Denmark	• Positive / Negative Interrelated (both negatively and positively) esp. at postgraduate level. It is "especially in connection with the thesis – that interrelationships are able to come into play between research and teaching." • Disciplinary differences: At the undergraduate level: Research and teaching are more related in the humanities than in the natural sciences. At the postgraduate level: (reverse) They are more related in the natural sciences than in the humanities.
The Research Assessment Exercise, Funding and Teaching Quality	Jenkins, 1995	• Postal survey: individual teaching geographers in 14 departments • Subject: geography • Country of study: England and Wales in UK	• Negative The "RAE is at present having a negative impact on undergraduate teaching and pushing it down the universities' agenda." • Disciplinary differences (not applicable)
Merging in a Seamless Blend. How Faculty Integrate Teaching and Research	Colbeck, 1998	• Observation: 12 Professors • Interview: 39 staff (including 12 observed professors, 18 their colleagues and 9 deans) Self-reported information on research and teaching. • Subjects: English and Physics in 2 universities. • Country of study: US	• Faculty integrate research and teaching on average during 1/5 of their work time. • Disciplinary differences: English as a soft subject with flat and expansive knowledge development is easier than Physics for staff to integrate research and teaching at both undergraduate and graduate levels. Physicists have more opportunities than English faculty to integrate research and teaching in research training process.

Teaching and Research: Student perspectives and Policy Implications	Jenkins, Blackman, Lindsay & Paton-Saltzberg, 1998	• 8 Focus groups of undergraduate students Self report of the link between research and teaching. • 8 Subjects: Adult Nursing, Anthropology, English Studies, Educational Studies, Catering Management, Planning Studies, Business Administration and Biology. • Country of study: UK	• Positive / Negative Perceived benefits and disadvantages of staff research. • Disciplinary differences "The critical role of fieldwork in anthropology made students more aware of research and the importance of their staff doing research in a way that was not so readily apparent to students in other disciplines."
Research and Teaching at a Research University	Serow, 2000	• Interview: 29 senior teaching staff in a research university (27 had associate or full professorship) and 3 administrators. Self report of the two roles. • Documentary analysis: publicly accessible archival material (eg. Faculty handbooks); Personal documents (eg. CV, course syllabi) • Subjects: Natural, Applied and Behavioural Sciences • Country of study: US	• Positive / Negative "Research outranked teaching in the university's faculty reward system." 15 of the 29 perceive the roles of researcher and teachers as competitive. 7 of the 29 perceive the two roles are complementary. • Disciplinary differences Teaching staff express the necessity to combine research and teaching "especially in applied science fields with close links to a specific industry".
Relationship Between Teaching and Research in Higher Education in England	Coate, Barnett & Williams, 2001	• Interview: 24 heads of departments in 8 universities. • Focus group: 24 focus groups of staff in 8 universities; also focus groups with either research or undergraduate students in most departments. • Subjects: History, Chemistry, Engineering and Business study • Country of study: UK	• Positive / Neutral / Negative Six possible relationships were found: integrated, 2 positive types (research to teaching; teaching to research), independent, 2 negative types (research to teaching; teaching to research) • Disciplinary differences: "In humanities the relationship between teaching and research may be more direct at the undergraduate level, whereas at postgraduate levels the relationships is more direct in the sciences."
Experiences of the Relation between Teaching and Research: What do Academics Value?	Robertson & Bond, 2001	• Interview: 7 male both new and very senior lecturers in one university. • Email communication: 2 male staff. • Subjects: Engineering, Economics, Linguistics, Mathematics, Plant and microbial science, Physics. • Country of study: New Zealand	• Positive / Negative 5 types of the relationship were found. eg. "Research and teaching are mutually incompatible activities." "Little or no connection exists between research and teaching at undergraduate level." "Teaching and research share a symbiotic relationship in a learning community." • Disciplinary differences (not identified)

markedly greater than vice versa." (ibid.) In addition, two serious negative effects of research on teaching are also identified: "(1) the specialised research – and the demands of scientific merit (status) – may result in teachers riding hobbyhorses and (2) that the requirements of teaching may split up the time available for research to the extent of ruining it." (ibid.: 20-21)

In a similar vein, Jenkins et al. (1998) conducted eight focus groups with four to six undergraduate students in each group asking their opinions on the link between research and teaching. Students perceive both benefits and disadvantages of staff research. The benefits of staff research include staff enthusiasm, credibility of their teaching and institutional reputation. However, it also reveals that "some staff are not interested in teaching students." (ibid.: 127) The drawbacks of staff research involve: (1) "staff were not available to students"; (2) "they seemed preoccupied with their research at the expense of teaching"; (3) "in certain cases, staff research could have too great an influence on the curriculum" and (4) "students did not perceive themselves as 'stakeholders' in staff research." (ibid.: 133)

An uncertain result is also found in Serow's study in the US. (2000) Twenty nine senior staff holding associate professorship or higher in a research university were interviewed. Serow found that while about a quarter of the senior staff (7 of the 29) think the roles of researcher and teacher are complementary, half of them (15 of the 29) regard them as being competitive. The complementary version is especially shared among staff in applied sciences who "placed teaching alongside research and extension as interdependent (though not necessarily equal) parts of the university's mission." (ibid.: 456) Staff with the competitive view "agreed that the undergraduate faculty were agents of economic opportunity but claimed that their effectiveness had been compromised by the university's undue emphasis on externally funded research". (ibid.: 457) In other words, research can get in the way of teaching. Five or six of the senior staff interviewees had to permanently abandon their own funded research projects in order to focus on undergraduate teaching. One of these "ex-researcher" states that "I'm not held in as high esteem in our department as some of our researchers. I don't think that's appropriate. I doubt that I'm paid as much. But am I doing as much good for society? Quite a bit more, actually." (quoted in Serow,

ibid.: 459) Serow reasons that the competitiveness between research and teaching is mainly caused by "the low regard that is generally attached to undergraduate teaching and advising." (ibid.) Therefore, according to him, "a complete commitment to those activities takes on altruistic qualities, particularly when it is freely chosen." (ibid.) He suggests that the low status of teaching results from the flawed methods of promotion and recruitment on the basis of research productivity adopted by universities. In other words, a good record of research productivity does not reflect good teaching. Good teaching is "inherently local in nature" and good teachers are simply "excellent teachers who served the university extremely well." (ibid.: 460)

Coate, Barnett and Williams (2001) shows a similar picture. Their study involves twenty four departments in eight higher education institutions. In each department, the head was interviewed and a focus group was formed by the staff. In most cases, it is followed by a focus group with either research or undergraduate students or both. Six relationships between research and teaching are found: integrated; positive effect from research on teaching; positive effect from teaching on research; independent; negative effect from research on teaching; negative effect from teaching on research. For example, in a positive relationship when teaching benefits research, it is perceived that:

> • Research benefits from teaching because it forces lecturers to articulate their research ideas and open them to challenge from students:
> • Teaching in less familiar areas on undergraduate courses may lead to new ideas for research;
> • In some subject areas in the sciences, we were told that research students were the 'backbone' of the research conducted in the department;
> • Students' ideas may stimulate a new research direction.
>
> (ibid.: 168)

It is also found that research, as a negative influence on teaching, is due to the fact that "research often has a higher value than teaching." (ibid.: 170) The evidence for teaching as a negative influence on research is the heavy workload, diminishing morale of staff and a stressful and depressed personal life as a result. They argue that "positive relationships between teaching and research, however, are unlikely to result unless the appropriate and adequate resources are strategically managed to this end." (ibid.: 173)

On the other hand, Jenkins (1995), Colbeck (1998) and Robertson and Bond (2001) find more disparities than complementarity in the relationship between research and teaching. Jenkins (1995) conducted a postal survey to individual geographers in 14 departments in England and Wales. He deliberately chose those informants who were not heads of department but were heavily involved in undergraduate teaching and were active researchers and above all, willing to report frankly. He discovered that "the general pattern in appointments and promotion is, for greater emphasis, to be placed on research productivity and potential *vis-à-vis* teaching; many more students are experiencing a fragmented experience." (ibid.: 6-7) According to the data, he reasons that "the RAE has significantly shaped what "counts" as scholarly activity and in particular is deterring staff from researching and writing for discipline-based pedagogic journals and writing/producing teaching related materials, in particular student textbooks and information technology-based teaching materials." (ibid.: 7) This result is echoed by Colbeck (1998). She points out that "the mean proportion of integrated teaching and research time for the sample of twelve faculties was 19%." (ibid.: 664) In other words, during four fifths of an academics working, research and teaching are not integrated.

Robertson and Bond (2001) identify five types of experiences on the relationship between research and teaching:

> A. Research and teaching are mutually incompatible activities;
> B. Little or no connection exists between research and teaching at undergraduate level;
> C. Teaching is a means of transmitting new research knowledge;
> D. Teachers model and encourage a research/critical inquiry approach to learning;
> E. Teaching and research share a symbiotic relationship in a learning community.
>
> (ibid.: 10)

The incompatibility between the two manifests itself in the fact that research and teaching compete with each other for time and attention. More importantly, "engagement in cutting-edge research can detract from the ability of a teacher to communicate ideas at the basic level." (ibid.: 11) For example, one staff said:

> ... all the publicity from this university and from several others that I've been familiar with, reckons that there's this ... awfully strong link between teaching and research to the extent that you can't possibly separate them ... that just conflicts so much with my own experience of

> universities right from when I was first a student, but the evidence around me says that there isn't any relationship.
>
> (ibid.: 11)

Some informants perceive teaching as enhanced by research through enthusiastic transmission of the new knowledge, for example "Those people who are keen on their research, conduct good research, also make the best teachers. They're fresh, enthusiastic, informed, they feed it into their students, you know, it just livens up their whole form in front of the class." (ibid.: 12)

3.1.2.1 Disciplinary Differences

With regard to the disciplinary differences, findings of exploratory research suggest more consistent outcomes than correlational studies. Firstly, five out of six studies with two or more subjects involved indicate disciplinary differences. Only one of them, Robertson and Bond (op. cit.) with 6 subjects, does not mention the disciplinary variation of the relationship between research and teaching. Secondly, the findings suggest that research and teaching are seen to be more related in the humanities than in the natural sciences at least at the undergraduate level. (Jensen, op. cit.; Colbeck, op. cit.; Jenkins et al., op. cit.; Coate et al., op. cit.) Jensen's study (op. cit.) involved three main areas: the natural sciences, the social sciences and the humanities, with Chemistry, Economics and French as cases in one university. Jensen found that research and teaching at the undergraduate level are loosely related in Chemistry, while the teaching environment in French allows more "research-related discussion". In Jensen's opinion, this is because humanities research is less internationally integrated than scientific research. It is also highly individualistic compared with its counterpart in the sciences where most research is carried out in groups. According to Jensen, the basic premises of humanities are open for discussion with even the first year undergraduate students. This provides better opportunity for research to enhance teaching.

Colbeck (op. cit.) studies two subjects, English and Physics at two universities. She comes to a similar conclusion: English provides more opportunities than Physics to

integrate research with classroom-oriented teaching. She suggests that "the flat and expansive nature of knowledge development made it relatively easy for English faculty to teach their current research to undergraduate as well as graduate students." (ibid.: 656) Moreover, "lack of consensus about appropriate curriculum and course content gave English faculty flexibility to design courses related to their research." (ibid.)

In the study of Jenkins et al. (op. cit.), eight disciplines were chosen in one university: Adult Nursing, Anthropology, English Studies, Catering Management, Planning Studies, Business Administration and Biology. They found that "Anthropology students (year 3) were most aware of individual staff research interests and the role of research in the curriculum they experienced." They reason that it is because the important role of fieldwork played in Anthropology raises students' awareness of staff research.

Coate et al. (op. cit.) selected four subjects at eight universities: history, chemistry, engineering and business studies as examples from three main areas: arts and humanities, science and technology, and professional subjects. They found that compared with the sciences, "the relationship between teaching and research may be more direct at the undergraduate level" for the humanities (ibid.: 167) They suggest that these differences could be caused by "institutional and departmental strategies." (ibid.)

Serow's study (op. cit.) explores the disciplinary variation among the science subjects. He interviewed senior staff with professorships who were also active in the undergraduate education of the natural, applied and behavioural sciences at one university. He found that among the science subjects, senior staff in applied sciences are more inclined towards the view of the complementarity between research and teaching than those in the natural and behavioural sciences. This is due to the close links between the applied sciences and industry. A professor in the applied sciences states: "the ultimate certification is: Can our students get a good job? Our industrial allies are impressed ... They want to go with a winner." (ibid.: 457)

3.1.2.2 Brief Summary

To sum up, most of the exploratory empirical studies at the individual level reveal both complementary and competitive sides of the relationship between research and teaching. Some of them highlight the disparities between them. (Jenkins, 1995; Colbeck, 1998; Robertson & Bond, 2001) The findings also suggest that research and teaching are more closely related in humanities than in sciences.

3.1.2.3 Comments on Exploratory Studies

Care is necessary in interpreting the exploratory empirical research on this topic. In response to these studies, at least four issues emerge: triangulation, the validity of student focus groups, the importance of the relationships and the asymmetric nature of the link.

The first point that I would like to discuss is triangulation. In order to avoid the situation of being misinformed or to reduce the likelihood of misinterpretation, researchers are expected to incorporate multiple observers, theories, methods, or data resources. (Denzin, 1970: 313; Frankfort-Nachmias & Nachmias, 1996: 205; Gall, Borg, & Gall, 1996: 574; Fraenkel & Wallen, 2000: 506) "Triangulation is not a tool or a strategy of validation, but an alternative to validation." (Denzin & Lincoln, 1998: 4; Denzin & Lincoln, 2000: 5; see also Flick, 1998: 230) Denzin (1978) identified four types of triangulation. The fifth one was added by Janesick (1998). They are as follows:

1. *Data triangulation*: the use of a variety of data sources in a study;
2. *Investigator triangulation*: the use of several different researchers or evaluators;
3. *Theory triangulation*: the use of multiple perspectives to interpret a single set of data;
4. *Methodological triangulation*: the use of multiple methods to study a single problem.

(Denzin, 1978: 294-304; Denzin & Lincoln, 2000: 391)

> 5. *Interdisciplinary triangulation*: the use of multiple disciplines to explore a single topic. (Janesick, 1998: 47)

From this point of view, it is noticeable that most exploratory studies only involves the staff's point of view. This may lead to two problems. Firstly, the student's voice is overlooked. One of the key roles of the university is to deliver knowledge to the students and as a result, they are legitimate evaluators of teaching performance. Owing to the lack of students' voices, those studies may be invalidated by possible vital configurations that may account for the relationship between research and teaching.

The second potential problem is related to the first type of triangulation – data triangulation. According to Denzin, data triangulation means "researchers explicitly search for as many different data sources as possible which bear upon the events under analysis". (1978: 295) It is different from methodological triangulation for "the latter term refers to research methods per se, and not to sources of data as such." (ibid.) The data triangulation is crucial because "if we ask respondents to report on their behaviour verbally (interviewing), we have no guarantee that their actual behaviour ... is identical to their reported behaviour." (Frankfort-Nachmias & Nachmias, op. cit.: 205) Following Frankfort-Nachmias and Nachmias's logic, staff's perceptions may not be identical to their actual teaching behaviour in the classroom. More importantly, when providers and receivers refer to different groups of people as always happens in the case of education, there is no guarantee that the staff's perceptions are identical to the students' learning experiences. Consequently, the data triangulation is especially important in educational research with regard to students' experiences.

Unfortunately, none of the above exploratory studies uses data triangulation to verify the staff's perceptions. It is dangerous to assume what the staff believe is what happens in the educational settings. Only two of them, Colbeck (1998) and Serow (2000), adopt more than one research method. Apart from interviewing staff, Colbeck observed twelve professors and Serow used documentary analysis. In Serow's study, two types of documents were involved: publicly accessible archival material (faculty handbooks, records of contracts and grants, and minutes of

committee meetings) and personal documents from the interviewed staff (curriculum vitae, course syllabi and statements of teaching philosophy). (ibid.: 453) Serow also interviewed three administrators for triangulation. However, only Colbeck's research presents the results of the comparison between the staff's perceptions and the researcher's (Colbeck's) observations. Even then there is no guarantee that the researcher's observation, the administrators' perceptions or the related documentary are identical to what the students experience.

The second issue concerns the appropriateness of using student "focus groups" as a research method in some of the studies in probing the debate at the individual level. It is not very clear how the research method of focus groups with students can generate valid data regarding the 'individual' level of the relationship. It faces a number of difficulties. In doctoral education especially in the social sciences, most supervision involves mainly a one-to-one interaction between students and their supervisors. The relationship with the supervisor plays a critical role in a student's learning process. If the relationship does not work, it can directly influence the quality and quantity of the supervision given to students. Under those circumstances, jeopardising the relationship with supervisors will be the last thing that doctoral students would like to see. Telling others about the problems with a certain staff member who is also known to others can pose a threat to the relationship. Therefore, is it safe for students to reveal their difficulties in relation to their own supervisors in a focus group? However, it does not mean that the issue of supervision cannot be explored. It needs to be handled with great sensitivity, confidentiality and caution. In addition, if the student informants are supervised by different academics, the situation will be more complex. Is it possible and appropriate to draw conclusions about the relationship between staff research and teaching at the individual level when the student informants refer to different academics?

The third point is related to the importance of the relationships. Most exploratory empirical studies suggest that more than one type of relationship exists between research and teaching. These categorisations and *only* the categorisations can lead to two problems. Firstly, those studies tend to ignore the degree of importance among the different facets of the relationship. All the different types of link are given equal

weight leading to the lack of an illuminating perspective. Describing everything by giving the same amount of attention to every bit actually explains nothing.

Next, the exploratory studies have so far answered the question on what kind of relationship exists between research and teaching. However, one of the key questions of the debate is left unanswered: to what extent does research enhance or deviate from teaching? In order to answer this question, the exploratory research has to be designed in a way that it not only explores the complexity of the relationship but also investigates the comparative importance among them. Unfortunately, none of them delves further into either the degree of the significance among the diversities of the relationship or the degree of influence of each relationship on the students' learning.

Last but not the least, it is interesting to know that at least four studies explicitly point out the asymmetric nature of the relationship between research and teaching: Jensen, 1988; Jenkins, 1995; Serow, 2000 and Coate et al., 2001. The asymmetric link is reflected in two ways: (1) staff perceive that research enhances teaching more than the other way round; (2) research is more valued than teaching.

> "This investigation (like that of e.g. Maier-Leibnitz, 1984) does, however, clearly point out that there is a considerable asymmetry in this interrelationship, i.e. the influence of research on teaching is assessed as being markedly greater than vice versa." (Jensen, op. cit.: 20)
>
> "... the general pattern in appointments and promotion is for greater emphasis to be placed on research productivity and potential *vis-à-vis* teaching; many more students are experiencing a fragmented experience." (Jenkins, op. cit.: 6-7)
>
> "A major point of agreement among the interviewees was that research outranked teaching in the university's faculty reward system, and that externally funded research and publication in appropriate outlets were essential not only for promotion and tenure but also for maintaining esteem in the eyes of one's peers." (Serow, op. cit.: 453)
>
> "There were also claims that research benefits from teaching, although this was less commonly discussed than the other relationships" (Coate et al., op. cit.: 168)

If the asymmetric relationship found in the research is true, then it suggests that research and teaching do not form a balanced relationship. This firstly means that

teaching is more likely to be sacrificed if research is under pressure. Secondly, without an evenly balanced interaction between research and teaching, one of them will always play the dominant role. This can increase the difficulty in building up a healthy and positive relationship between them in the long run. It is natural to reason that a positive and mutually beneficial relationship only exists when the two parties are treated and valued equally.

3.2 Empirical Findings at Aggregate Level

The second level at which the relationship between research and teaching can be discussed is that of the department, or the university, as an organization. Do departments need to ask staff to be active researchers in order to provide lively academic environments for students? Fourteen major empirical studies were found over the last ten years. Among those empirical studies, eleven of them are correlational research; three of them are exploratory. In correlational research, correlation coefficients were given in five of the thirteen, while in the remaining six, the authors did not give correlation coefficients. Correlational empirical studies which are summarised in Table 3-4 and Table 3-5 will be explored first, followed by the exploratory empirical studies in Table 3-6.

3.2.1 Correlational Studies at Aggregate Level

With regard to the relationship between research and teaching at the aggregate level, it is found that one of the eleven correlational studies (Table 3-4, Table 3-5) claims a positive link (Johnston, 1994); three indicate a negative relationship (Ramsden & Moses, 1992; Fox, 1992; Astin & Chang, 1995); five discover a neutral relationship (Feldman, 1987; Volkwein & Carbone, 1994; Braxton, 1996; Hattie & Marsh, 1996; Patrick & Stanley, 1998). The remaining two studies present more than one type of the relationships (Gottlieb & Keith, 1997; Tang & Chamberlain, 1997). Among them, the findings of Ramsden and Moses (1992) at the aggregate level are also examined. (compared with section 3.1.1)

Table 3-4: Correlational Studies with Correlation Coefficient on Research and Teaching at the Aggregate Level

(r: Pearson's r. p: p value or significance level.)

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Research Productivity and Scholarly Accomplishment of College Teachers	Feldman, 1987	• Statistical analysis of 29 empirical studies with teachers' research productivity and students' assessment of teaching effectiveness	• Neutral (r=.13, p<.001) "The likelihood that research productivity actually benefits teaching is extremely small or that the two, for all practical purposes, are essentially unrelated." • Disciplinary differences: Research and teaching "for humanities and social sciences are more strongly related (positively) than they are in professional areas,...and that the two are unrelated for natural science faculty."
Association between Research and Teaching in Australian Higher Education	Ramsden & Moses, 1992	• Questionnaire: about 1,780 full time staff in 18 institutions. Self-reported research and teaching commitments. • Questionnaire: students in Accounting departments in 51 institutions. Students' perceptions of teaching. • Subject: Accounting • Country of study: Australia	• Negative (r=-.36; -.49; p<.0001) r=-.36 with self-reported teaching commitments r=-.49 with student appraisals of teaching effectiveness "The results for the whole sample showed a negative association between research and teaching." • Disciplinary differences: (not identified)
The Impact of Departmental Research and Teaching Climates on Undergraduate Growth and Satisfaction	Volkwein & Carbone, 1994	• Questionnaire: 655 students in 27 departments in 1 university. Students' assessment and deans' rating of teaching climate. University data and deans' rating for research climate. • Interview: deans, chairs • Country of study: US	• Neutral (r=-.22 ~ .06, p<.05) "This strongly suggests that teaching and research climates are relatively independent of each other." • Disciplinary differences: (not identified)
Colleges That Emphasise Research and Teaching. Can You Have Your Cake and Eat It Too?	Astin & Chang, 1995	• Questionnaire: 97 faculties in each of the 212 institutions Evaluation of staff attitudes on research-oriented and student-oriented questions • Country of study: US	• Negative (r=-.69, p?) "Research Orientation and Student Orientation have a strong negative correlation (r=-.69)" • Disciplinary differences: (not identified)
Relationship between Research and Teaching: a Meta-Analysis	Hattie & Marsh, 1996	• Statistical analysis of 58 empirical studies with both teachers' self-reported and students' perceptions of teaching effectiveness (including 29 of Feldman, 1987) • Country of author: US & Australia	• Neutral (r=.06, p<.05) (same as Feldman, 1987) • Disciplinary differences: "The relationship between teaching and research is greater for the social sciences than for humanities, followed by the natural sciences."

Table 3-5. Correlational Studies with No Correlation Coefficient Given on Research and Teaching at the Aggregate Level

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Research, Teaching and Publication Productivity: Mutuality Versus Competition in Academia	Fox, 1992	• Questionnaire: 3,968 academic staff. Self-reported research assessment and 'teaching investment'. • Subjects: Social sciences faculty- Economics, Political Science, Psychology & Sociology. • Country of study: US	• Negative (regression coefficients) "In relation to publication productivity, the teaching and research investments measured here appear to be at odds." • Disciplinary differences: (not identified)
Commentary. Is There a Correlation Between Research and Teaching Quality?	Johnston, 1994	• Statistical analysis of the 1992RAE vs. the 1993QAT (Quality Assessment of Teaching) • Subject: Chemistry, Engineering, History, Law. • Country of study: UK	• Positive "The departments rated highly for their research were also much more likely to be rated highly for their teaching." • Disciplinary differences: (not identified)
Contrasting perspectives on the Relationship Between Teaching and Research	Braxton, 1996	• "Vote-counting" method: category analysis of 30 studies (including 29 in Feldman, 1987)	• Neutral "Research does not interfere with teaching effectiveness." • Disciplinary differences: (not identified)
The Academic Research-Teaching Nexus in Eight Advanced – Industrialised Countries	Gottlieb & Keith, 1997	• Questionnaire: 13,984 faculty staff in 8 countries. Staff perceptions of research and teaching. • Countries of study: US, Australia, UK, Korea, Israel, Germany, Sweden, Japan.	• Neutral / Negative "On the one hand, the majority of the respondents reject the statement that research commitments reduce the quality of teaching. On the other hand,...the respondents lean toward the competitive point of view." • Disciplinary differences: (not identified)
Attitudes Toward Research and Teaching. Differences Between Administrators and Faculty Members.	Tang & Chamberlain 1997	• Questionnaire: 209 administrators and 384 full-time faculty in 6 institutions. Staff perceptions of research and teaching. • Country of study: US	• Positive / Negative Administrators perceive "research and teaching are mutually supportive." Faculty members perceive that they "have not been rewarded for their teaching activities...., that research interferes with teaching." • Disciplinary differences: (not identified)

Teaching and Research Quality Indicators and the Shaping of Higher Education	Patrick & Stanley, 1998	• Statistical "Cluster analysis": the 1996RAE vs. the TQA (teaching quality ratings) • Subject: Business and Management Study • Country of study: UK	• Neutral "There is no consistent connection between high quality in research and high quality in teaching." • Disciplinary differences: (not applicable)

To begin with the positive relationship, Johnston (1994) compares results of the 1992 Research Assessment Exercise and the 1993 Quality Assessment of Teaching in Chemistry, Engineering, History and Law. Johnston found that:

> The probability of achieving an excellent QAT grade was eighteen times higher in a grade–5 department from the last RAE than it was in a grade-1 department, whereas the probability of being assessed as satisfactory only after a visit (the vast majority of which were undertaken to test a prima facie claim of excellence) was nearly nine times higher in a grade-1 than a grade-5 research department.
>
> (Johnston, ibid.: 1493)

Johnston therefore concludes: "The outcomes show a very clear relationship between performance in the two exercises: the departments rated highly for their research were also much more likely to be rated highly for their teaching." (ibid.)

However, Fox (1992), Ramsden and Moses (1992) and Astin and Chang (1995) disclose a different connection: research and teaching are negatively related at the aggregate level. Fox (1992) distributed questionnaires to a random sample of 3,968 staff in four subjects of the social sciences in the US: Economics, Political science, Psychology and Sociology. Staff were asked to report their own record of publications and their attitudes towards 'departmental reward structure', 'importance of aspects of academic roles and work', 'teaching loads' and 'time investments'. It is found that "in relation to publication productivity, the teaching and research investments measured here appear to be at odds." (ibid.: 299) Fox concludes that "research and teaching do not represent aspects of a single dimension of academic investments, but are different, conflicting dimensions." (ibid.: 293)

This is echoed by the findings of Ramsden and Moses' research at the aggregate level (1992, see section 3.1.1). Different from the calculation at the individual level, the correlation between research and teaching at the aggregate level is calculated by the average research productivity, and the equivalent staff self-reported teaching

commitment and student ratings of teaching. The staff self-reported teaching commitments were collected from questionnaires sent to 1,780 staff in 18 institutions (described in section 3.1.1). The student ratings of teaching were obtained using "Course Experience Questionnaire" (ibid.: 282) in 51 Australian accounting departments. Ramsden and Moses show that at the aggregate level the correlation coefficient between research productivity and staff self-reported teaching performance is -.36 ($p<.0001$). It demonstrates that "highly productive departments are populated by staff who are on average less effective teachers – and vice versa." (ibid.: 287) If the staff self-reported teaching is substituted for students' perceptions of teaching, the correlation coefficient is -.49 ($p<.0001$). It points out that "a negative association between students' perceptions of the quality of teaching and research productivity at the level of the academic department is evident." (ibid.: 288)

In a similar vein, Astin and Chang (1995) sent questionnaires to staff at 212 institutions in the US. The average number of staff in each institution is 97. The research is carried out at the aggregate level because it is designed to measure the institutional "climate" of research and teaching. (ibid.: 45) The research climate is obtained by ten "Research Orientation" questions. Examples of "Research Orientation" questions are: "How many articles have you published in academic or professional journals?" "Do your interests lie primarily in teaching or in research (scored for research)?" "How important for you (as a personal or professional goal) is engaging in research?" (ibid.) On the other hand, the teaching climate is measured by seven "Student Orientation" questions. Examples of "Student Orientation" questions are: "Faculty here are interested in students' academic problems." "Faculty here are interested in students' personal problems." "There are many opportunities for student-faculty interaction." (ibid.: 46) They found that the correlation coefficient between the "Research Orientation" and "Student Orientation" is significantly negative (-.69). "Given that Research Orientation and Student Orientation have a strong negative correlation (r =-.69), it was not surprising to find that 10 of the 20 institutions with the strongest Research Orientations are also among the 20 with the weakest Student Orientations". (ibid.)

On the other hand, Feldman (1987), Volkwein and Carbone (1994), Braxton (1996), Hattie and Marsh (1996) and Patrick and Stanley (1998) find that research and

teaching have no significant relationship at the aggregate level. Feldman (1987) carried out an aggregative research: statistical analysis of 29 correlational studies, which have teachers' research productivity on the one hand and students' assessment of teaching effectiveness on the other. It is found that:

> Of the 29 studies with summary *r*'s, 21 use the number of scholarly publications of the faculty member of measure productivity. The average correlation coefficient across these studies is +.13 (combined Z = + 13.132; p<.001). Of these 21 studies, 10 measure the teacher's *current productivity* (of the more immediate past, the exact number of years varying by study), while 11 of them focus on "life-time" or *total career productivity*. Surprisingly, perhaps, these two subsets of studies, on average, show the same results. The average correlation across the first set of studies is +.13 (combined Z = + 13.418; p<.001), and that for the second set is +.14 (combined Z = + 5.351; p< .001)
>
> (original italics, Feldman, ibid.: 239)

Consequently, he concludes that "an obvious interpretation of these results is either that, in general, the likelihood that research productivity actually benefits teaching is extremely small or that the two, for all practical purposes, are essentially unrelated." (ibid.: 275)

In the research of Volkwein and Carbone (1994), 27 different academic departments at one US research university are involved. Four areas are measured: departmental research climate, department instructional (teaching) climate, academic integration and student outcomes. They found that

> the correlations among the separate teaching and research measures range from - 0.22 to 0.17. Eleven of the correlations are negative and fourteen are positive, but none are statistically significant. The two trichotomised scales show a low-positive but statistically insignificant relationship (r = 0.06).
>
> (Volkwein & Carbone, ibid.: 156)

In corresponding to Feldman's finding, it is concluded that "this strongly suggests that teaching and research climates are relatively independent of each other, and undercuts the rhetoric in the field which views research and teaching emphases to be either negatively or positively associated." (ibid.)

Almost ten years after Feldman's research, Braxton (1996) repeated it by using a different statistical method – "Vote-counting" method. Thirty correlational studies

are included. Among them, twenty-nine studies are used by Feldman and one additional study (Voeks, 1962) which Feldman reviewed is also considered in Braxton's calculations . These thirty studies are characteristic of their using student appraisals as a measure of teaching effectiveness. Braxton found that in terms of overall support, "both the Complementarity perspective (eleven of thirty studies) and the Null perspective (eighteen of thirty studies) receive moderate support." (op. cit.: 8) By "Null perspective", Braxton means that research and teaching are not related. In terms of institutional type, it shows that "the Null perspective receives strong affirmation in research universities." (ibid.) Braxton reaches two conclusions. Confirming Feldman's research, firstly, Braxton asserts that "research does not interfere with teaching effectiveness." (ibid.) This is especially based on the findings that the Null perspective receives strong confirmation from research universities. Secondly, "a systematic relationship between teaching and research role performance does not exist across different types of colleges and universities." (ibid.) This is derived from the finding that "the modest support provided both the Null and the Complementarity perspectives." (ibid.)

At the same time, Hattie and Marsh (1996) expand Feldman's research. Apart from the original 29 studies in Feldman's research, they added a further 29 studies. Different from Feldman, Hattie and Marsh also include studies with staff self-ratings of teaching effectiveness. They only exclude studies with staff self-ratings on *both* research and teaching. They found that:

> On the basis of 498 correlations from the 58 studies, the weighted average was .06. There was less than .1% of the total variability in common. The 95% confidence interval was between .061 and .066.
>
> (Hattie & Marsh, ibid.: 525)

They reach the same conclusion made by Feldman. "We must conclude, as did Feldman (1987), that 'the likelihood that research productivity actually benefits teaching is extremely small or that the two, for all practical purposes, are essentially unrelated....' (p.275) ... We must conclude that the common belief that research and teaching are inextricably entwined is an enduring myth. At best, research and teaching are very loosely coupled." (ibid.: 529)

Similar outcomes are found in Patrick and Stanley (1998). Patrick and Stanley use Cluster analysis to examine 92 departments, which have both teaching quality ratings and the 1996 research quality ratings on business and management studies in the UK. In a six-cluster analysis, cluster 1 consists of 4 departments that "have both the best research ratings and consistently 'excellent' teaching ratings." (ibid.: 34) Cluster 2 (10 departments) and Cluster 3 (17 departments) are similar apart from the fact that the former is characteristic of "excellent" teaching and the latter of "satisfactory" teaching. Cluster 4 (7 departments) has "excellent" teaching but with low percentages of research-active faculty. On the contrary, Cluster 5 (18 departments) has high percentages of research-active faculty but with "satisfactory" teaching. The final Cluster 6 (36 departments) basically is composed of those which have lowest research ratings and "satisfactory" teaching quality. Patrick and Stanley conclude that "clearly, there is no consistent connection between high quality in research and high quality in teaching, at least in business and management studies." (ibid.: 35)

The remaining two studies reveal rather inconsistent or inclusive results: Gottlieb and Keith (1997), Tang and Chamberlain (1997). Gottlieb and Keith analysed 13,984 staff questionnaires from eight countries. According to them, their analysis of the international data confirms Chen's study of the Israeli sample: "On one hand, the majority of the respondents reject the statement that research commitments reduce the quality of teaching. On the other hand, in evaluating the influence of specific conditions of teaching (i.e., the number of courses, number of students, etc.) on research activity, the respondents lean toward the competitive point of view." (Chen, 1993: 12 quoted in Gottlieb & Keith, ibid.: 413-414)

In contrast to previous studies, Tang and Chamberlain (1997) incorporate administrators' attitudes on the issue. They sent questionnaires to 209 administrators (i.e., 171 department chairs, 32 deans, and 6 academic vice presidents) and randomly selected 384 full-time faculty members of 6 universities in the US. The questionnaire measured attitudes towards the mission of the university, teaching, research and the reward systems. It is found that administrators and faculty members share different attitudes on the issues related to research and teaching. "Administrators tend to believe that research and teaching are mutually supportive and that both research and teaching are the mission of their university. ... They tend to have a weak endorsement

of the notion that teaching offers satisfaction, that research interferes with teaching, and that faculty should have strength in either teaching or research." (ibid.: 223) On the other hand, academic staff "believe that they have not been rewarded for their teaching activities. Further, they believe that they enjoy teaching, that research interferes with teaching, and that they should be required to do either teaching or research, but not both." (ibid.)

3.2.1.1 Disciplinary Differences

With regard to disciplinary differences, it is interesting that only two of the ten studies with more than one subject indicate disciplinary variation over the link between research and teaching. The two studies that identify disciplinary variation are Feldman (1987) and Hattie and Marsh (1996). In his analysis of 29 studies, Feldman identifies five studies with sufficient data for calculating correlation coefficients or its equivalent in the disciplines of the humanities, social sciences, natural sciences and professional areas. He found that research and teaching has a stronger positive relationship in the humanities than in the natural sciences:

> Using the data in this table, the average correlation for humanities is +.22 (combined Z= +4.540; p<.001); for social sciences, +.20 (combined Z= +4.851; p<.001); for natural sciences, +.05 (combined Z= -0.218; p= .827); and for professional areas (with data for only two studies) r = +.06 (Z= +1.973; p=.048)
>
> (Feldman, op. cit.: 270)

However, Feldman warns that care should be taken in drawing any conclusion in this area. For example, another study by Hoyt and Spangler (1976) in Feldman's analysis of disciplinary variance (ibid.), finds a positive relationship between research involvement and the students' perceived progress on "professional skills, viewpoints" "discipline's methods," "thinking, problem solving," and "personal responsibility" in the natural sciences. The negative relationship is found in the social sciences. Therefore, the tentative conclusion is that "research productivity and teaching effectiveness for humanities and social sciences are more strongly related (positively) than they are in professional area (although the correlation for the latter is based on only two studies), and that the two are unrelated for natural science faculty." (Feldman, op. cit.: 270) The possible reason is that "research in the natural sciences,

in contrast to research in social sciences and humanities, may be at a level of abstraction and complexity that renders it of little utility in the classroom." (Michalak & Friedrich, 1981: 593 quoted in Feldman, ibid.)

In their analysis of 58 studies, Hattie and Marsh (1996) reveal that the average correlation for the humanities is +.07, for the social sciences, +.10 and for the natural sciences, +.00. (ibid.: 524) Consequently, "the relationship between teaching and research is greater for the social sciences than for the humanities, followed by the natural sciences." (ibid.: 527) The findings of Hattie and Marsh are similar to Feldman's. Both suggest a near zero relationship in the natural sciences. Furthermore, Hattie and Marsh argue that the common belief in a more positive relationship in the humanities emphasising research originality and creative scholarship, than in the natural sciences underlining empirical research, is not verified. The reason is that correlations for the humanities and the natural sciences are both close to zero in their study.

3.2.1.2 Brief Summary

In summary, the majority of correlational studies at the aggregate level discover a neutral relationship between research and teaching. For possible disciplinary variation, it is only tentative to state that research and teaching may be slightly more positively related in the humanities and the social sciences than in the natural sciences. The correlations of the different disciplines are too small to draw any firm conclusions.

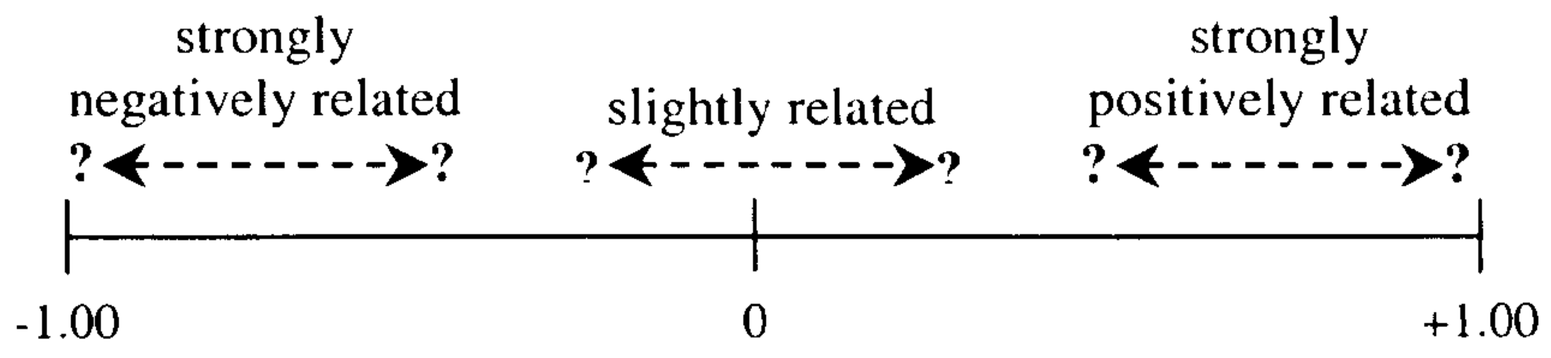
3.2.1.3 Comments on Correlational Studies

Two issues emerge from the review of these studies: magnitude of correlation coefficients and disciplinary variation. Firstly, six of the eleven correlational studies provide correlation coefficients: Feldman, 1987; Ramsden and Moses, 1992; Volkwein and Carbone, 1994; Astin and Chang, 1995; Hattie and Marsh, 1996; Braxton, 1996. It is unambiguous when the researcher derives his/her statements from data with a

large value of correlation coefficients. For example, Ramsden and Moses (op. cit.) and Astin and Chang (op. cit.) argue for a negative relationship between research and teaching based on the findings that the correlation coefficient values were found to be -.36 and -.49 for the former and -.69 for the latter.

However, when the correlation coefficient values are small, the decisions on whether the relationship between staff research and teaching is positive / negative is difficult to make. (see Figure 3.1) For example, based on the findings of the average correlation coefficient of .06, Hattie and Marsh claim that "the overall relationship between quality of teaching and research was *slightly positive*." (my italics, Hattie & Marsh, op. cit.: 525) In contrast, Feldman (op. cit.) and Volkwein and Carbone (op. cit.) indicate a neutral relationship between research and teaching when the value of the correlation coefficient is .13 for the former and when it varies from -.22 to .06 for the latter. It raises the question on how to pin down the right term to appropriately describe the statistical magnitude of the relationship.

Figure 3-1: Problem of Magnitude of Correlation Coefficients in the Literature



(source: compiled by the author from the materials discussed in the text.)

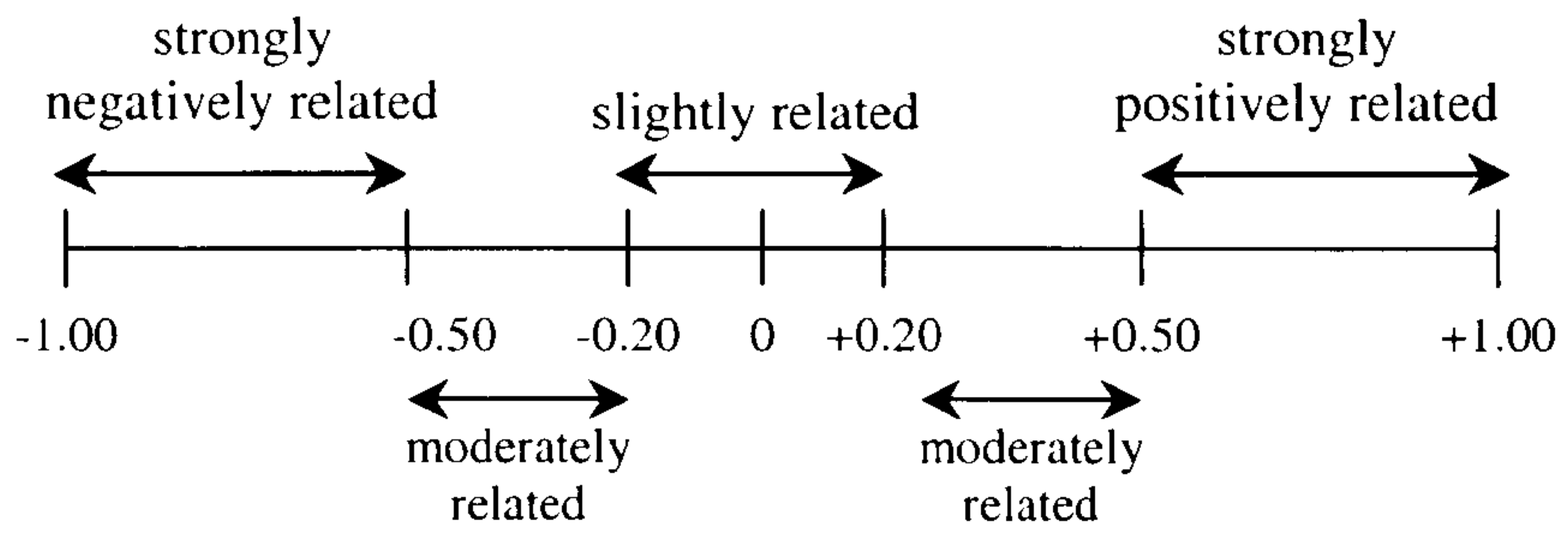
The value of a correlation coefficient varies from +1.0 to –1.0. As far as the social sciences are concerned, it seems that there is no solid agreement on how to draw the line among different degrees of the value, such as slightly positive, positive or highly positive. The general practice, however, is that "a correlation coefficient of +.10 to -.10 indicates that there is little, if any, relationship between the variables, whereas a coefficient of +.90 or -.90 indicates a strong relationship." (Hinkle, Wiersma & Jurs, 1988: 106) For example,

> Thus, if the correlation between two variables is +.20, you can tell at a glance that the relationship between them is positive and weak (since it

> is far from the maximum of +1). A correlation of -.80 would indicate a strong negative relationship.
>
> (Welkowitz, Ewen, & Cohen, 1976: 156)

Notwithstanding this practice, for psychologists and educational researchers, a correlation of .50 "is frequently considered high." (McCall & Kagan, 1990: 141) Therefore, this research would like to recognise +.20 or -.20 referred to as weak or slightly positive/negative relationship. Values greater than +.50 or smaller than -.50 will be regarded as having a strong or highly positive/negative relationship. (see Figure 3.2) This will also be applied to the data analysis in Chapter Six.

Figure 3-2: Defined Magnitude of Correlation Coefficients



(source: compiled by the author from the materials discussed in the text.)

Of course, in talking of the rule of thumb for interpreting the size of a correlation coefficient, the significance level, or p-value, cannot be ignored. The significance level is concerned with two issues: statistical significance and practical importance. Statistical significance focuses on answering the question of "How *sure* are we that H_0 [null hypothesis] is wrong?" (original italics, Schulman, 2000: 84) In other words, "the more convinced we are that the null hypothesis is wrong, the greater is the level of statistical significance." (ibid.) On the other hand, the practical importance of the result is faced by the question of "How *wrong* is H_0?" (ibid.) That is, "a hypothesis may be only slightly incorrect, or the true value of μ may be very far from the hypothesized value. The greater the disparity between the true value of μ and the hypothesized value, the greater is the practical importance of our obtained result." (ibid.: 84-85) Sometimes, we can find small (-.20 ~ +.20) but statistically significant correlation coefficients especially when the sample size involved is large. In these

cases, it is obvious that the null hypothesis, H_0, is wrong. This tiny difference between the two variables surely exists. However, how wrong is the null hypothesis? Due to the large size of the sample, the null hypothesis can be only *slightly* wrong. (ibid.: 89) Therefore, the practical importance of the effect can be "negligible". (for more examples and discussion, see ibid.: 89, 289-291)

The second issue is related to disciplinary variation. With a few exceptions (notably, Feldman, 1987; Hattie & Marsh, 1996), the majority of correlational studies at the aggregate level tend to mix data from different disciplines (the humanities, social sciences and natural sciences). Their results therefore can be confounded by possible disciplinary patterns that may account for the interaction between research and teaching. They may depict a different picture once the discipline factor is taken into consideration.

3.2.2 Exploratory Studies at Aggregate Level

Exploratory studies at the aggregate level reveal various outcomes. One of the three claims a positive relationship (Rowland, 1996; 2000a: 14-27), one a negative relationship (Drennan & Beck, 2000) and one reveals both positive and negative sides of the relationship (Vidal & Quintanilla, 2000).

Rowland (1996, 2000a) finds a positive relationship by interviewing 12 heads of departments at one large and old university in the north of England. The focus of Rowland's study is to understand staff's perceptions of the relationships between teaching and research. "All those interviewed expressed a view that active involvement in the research process directly improved the quality of teaching." (1996: 13; 2000a: 21) It is concluded that the "closer relationships between the two can provide the basis for a programme to improve the quality of university teaching." (1996: 7)

However, both Vidal and Quintanilla (2000) and Drennan and Beck (2000) paint another picture. Vidal and Quintanilla found that research and teaching is both negatively and positively related. 36 researchers in a medium-sized research oriented

Table 3-6: Exploratory Studies on Research and Teaching at the Aggregate Level

Empirical study	*Author/ Year*	*Research methodology / Sample*	*Findings*
Relationships Between Teaching and Research	Rowland, 1996 Rowland, 2000a: 14-27	• Interview: 12 Heads of departments in a university • Subjects: Arts and Sciences • Country of study: UK	• Positive "Active involvement in the research process directly improved the quality of teaching." • Disciplinary differences: (not identified)
Teaching and Research – Equal Partners or Poor Relations	Drennan & Beck, 2000	• Interview: 15 senior administrative staff at university level in 13 Scottish Universities • Country of study: Scotland, UK	• Negative "the RAE and the tensions which were created between teaching and research activity became a major focus of the work." "Research was more valued, and more highly rewarded, than teaching." • Disciplinary differences: (not identified)
The Teaching and Research Relationship within an Institutional Evaluation	Vidal & Quintanilla, 2000	• Interview: 36 researchers at a medium-sized research oriented University • Subject of interview: biological sciences • Report analysis: 20 self-assessment overall reports from 10 universities • Country of study: Spain	• Negative / Positive "it is difficult to carry out research if one has a lot of teaching to do." "it is easier to do research if at least your teaching is oriented to your research interests." • Disciplinary differences: (not applicable)

Spanish university were interviewed. The interview data is supplemented by 20 self-assessment reports from ten universities. Its aim is to find "to what extent this relationship is strong enough to support the idea that teaching and research should be analysed together from an institutional evaluation point of view". (ibid.: 217) The positive interaction between research and teaching is called 'transference'; the negative one 'interference'. They found the most commonly believed transference between the two is: "*it is easier to do research if at least your teaching is oriented to your research interests.*" On the other hand, the most common interference is that "*it is difficult to carry out research if one has a lot of teaching to do.*" (original italics, ibid.: 224) The general belief is that "an academic can research without teaching but cannot teach effectively without research" (ibid.: 225) Therefore, the Spanish academics think that they should do teaching and research together but only under the

condition that there is enough time to do research. (ibid.) Vidal and Quintanilla conclude that since research and teaching have great influence over each other – transference and interference, institutional evaluation should take both of them into consideration.

The tension between research and teaching is revealed in Drennan and Beck (2000). In order to explore the perceived impact of the Teaching Quality Assessments (TQAs) on thirteen Scottish universities, 15 elite staff are interviewed. Five of them are Assistant, Deputy or Vice Principal; six Directors of Quality or Quality assurance; two Directors of Learning and Teaching, or Educational Development and two Heads of Academic Staff Development units. Drennan and Beck found that

> Promotion criteria of all higher education institutions include performance in teaching, research and administration. Yet the prevailing perception is that research performance is the true discriminator. Amongst our interviewees, few believed that staff could move beyond a Senior Lecturer position, without high profile research activity. Only one institution had introduced posts which indicated that excellence in teaching and learning development was being highlighted and rewarded. Prizes for innovative development were contentious and adopted by only two of the thirteen universities in Scotland.
>
> (Drennan & Beck, ibid.: 10)

The dominance of research is strengthened by the difference between the financial rewards derived from high research ratings in the RAE and from 'excellent' ratings in TQA. "5* gets you millions, while an Excellent gets you 5% extra funded numbers." (ibid.: 8) Therefore, they argue that "only when the rewards are equalised will staff believe that teaching is an equal partner of research, and not its poor relation." (ibid.:10)

3.2.2.1 Brief Summary

In brief, the exploratory empirical studies at the aggregate level like those at the individual level reveal both complementary and competitive sides of the relationship. The findings are uncertain and inconclusive. Unfortunately, none of the three studies identify the disciplinary variations.

3.2.2.2 Comments on Exploratory Studies

Care again is required in interpreting those exploratory studies at the aggregate level. The findings can be limited by the following factors: data triangulation, the importance of the relationship, disciplinary factor and the asymmetric nature of the relationship.

To begin with, most of the exploratory studies at the aggregate level only have one data source – senior staff. The lack of data triangulation can face at least two difficulties. The first one is: are senior academic staff's perceptions identical to those of the younger staff? Senior academic staff with secure careers and less teaching loads may find research and teaching are easily integrated. On the other hand, the younger academic staff who are struggling to climb up their career ladders with heavy teaching loads may find research and teaching are constantly competing each other for time and energy. It is, therefore, dangerous to assume that the senior and younger staff share an identical view about the interaction between research and teaching. The second is: are senior academic staff's views identical to those of students? As addressed earlier, students who are those actually experiencing the education service are an important and valid source for examination of the teaching quality.

Next, most of the exploratory studies at this level like those at the individual level tend to overlook the importance of each relationship when more than one type of interaction is revealed. Without knowing the relative importance between them, it is difficult to make judgements on which of them possesses the most influential relationship and how it may jeopardise or enhance other types of relationships.

The third concerns the possible variances derived from different disciplines in the relationship between research and teaching. All three exploratory studies mix data from different disciplines, which can confound possible disciplinary patterns that may alter the nature of the interaction.

Moreover, all three studies point out the asymmetric nature of the relationship between research and teaching: Rowland (1996, 2000a), Drennan and Beck (2000)

and Vidal and Quintanilla (2000). The asymmetric relationship is manifested in following four ways:

(1) research is better funded than teaching:

> Part of the answer to this was financial. The recent arrangements for funding teaching and research in British Universities were generally held to favour research measures rather than teaching measures as being the more significant determinant of future funding.
>
> (Rowland, 1996: 10; 2000a: 18)
>
> Substantial amounts of money come because of your performance in the RAE – or don't come because of your performance.
>
> (Drennan & Beck, op. cit.: 8)

(2) research is more awarded and recognised than teaching:

> Research has always been the activity which brought status among academic colleagues and rewards in terms of promotion. The RAE has possibly made this worse.
>
> (Drennan & Beck, ibid.: 8)

(3) research is easier to assess than teaching:

> Without any prompting, almost every respondent said that one reason why teaching was valued less than research was because of the difficulties of assessing teaching.
>
> (Rowland, 1996: 10; 2000a: 18)
>
> The real difficulty of this is in evaluation. You can measure a research grant in pounds and count the number of research papers – and probably see an innovation as well – but the person who is just an extremely good teacher ... it is difficult to get the evidence.
>
> (Drennan & Beck, op. cit.: 9)

(4) staff perceive that research enhances teaching more than the other way around.

> Academics in Spain believe that the transference between research and teaching flows only in one direction, from research to teaching, and that although interference flows in both directions, the most important flow is from teaching to research. In other words, academics think that most efforts to improve research activity and quality will be good for teaching quality. By contrast, most efforts devoted to improve teaching will be bad for research.
>
> (Vidal & Quintanilla, op. cit.: 226)

If the asymmetric relationship found in the studies here is true, then it suggests that it is difficult for research and teaching to form a balanced relationship. When research is favoured in any of the above ways, it is likely to play a dominant role. Following this logic, teaching is likely to be sacrificed if research is under pressure. As argued

in the section of exploratory studies at the individual level, the failure of a balanced relationship can lead to the failure of a positive relationship in the long run.

3.3 Brief Evaluation of Previous Works

In brief, the majority of the correlational studies at the individual level tend to find either negative or neutral relationships between research and teaching. Only one of them reveals a positive relationship. The major problems shared by most of the correlational studies at this level are their research analysis and samples.

Exploratory research at this level reveals more than one type of relationship. In other words, the results are uncertain. Exploratory studies tend to have the following problems: data triangulation, the dubious use of student focus groups to collect data at the individual level and a failure to demonstrate the importance of the relationships. Many of the studies point out the asymmetric nature of the relationship between research and teaching. Research is more valued than teaching in various ways.

At the aggregate level, the majority of correlational studies find a neutral relationship between research and teaching. After careful examination of these studies, it is found that most of the studies face the issues of the magnitude of correlation coefficients and mixing data from different disciplines.

Regarding exploratory studies at this level, the findings are inconclusive. One of them discloses a positive relationship; one divulges a negative link; one has an uncertain result. It is found that most of them face the problems of using one data source, overlooking the significance among different types of the relationship, mixing data from different disciplines. The asymmetric nature of the relationship is also revealed in those studies.

The discussions of the empirical studies on the link between research and teaching at both the individual and the aggregate levels demonstrate that the findings are inconclusive. In addition, the contradictory findings (between the sciences and social

sciences, between correlational and exploratory studies, and between data obtained from students, younger academics and senior staff) also need further investigation.

Chapter Four

Doctoral Education

Doctoral education although it has not attracted much attention in the past has long been a distinguishable sector in higher education. The main focus of the research/teaching debate and the majority of previous empirical studies as reviewed in Chapter Two and Chapter Three concentrate mainly on undergraduate education. The relationship in doctoral education remains largely unknown or unexplored. (section 1.1) Although the previous empirical studies at this level are very limited, they will be examined later in this chapter.

This chapter will first present the purpose of doctoral education mainly from British official point of view. It then discusses the transformation which has been undertaken in British doctoral education during the past two decades. Important research on doctoral education is reviewed in the third section. Finally, a special focus of the empirical studies of the relationship between research and teaching at the doctoral level is presented.

In the process, it is hoped to not only highlight the points that firstly teaching itself comes in different forms in doctoral education and secondly that there is very little academic research into the research/ teaching relationship at the doctoral level. It sheds light on the concept of doctoral education that will be used in the design of the questionnaire in the next chapter.

4.1 The Purpose of Doctoral Education

The European tradition of doctoral education emphasises the contribution to knowledge rather than personal development and specialised research training. (Blume, 1995) According to Blume, "further scientific work, leading to the title of 'doctor', was not conceived as a training in research, but as research itself." (ibid.: 11) However, the traditional European model faced a number of difficulties in the UK

during 1980s. The questions raised concern not only "why it took some people so long to complete their doctorate" but also "whether the doctorate in its present form was needed." (Becher, Henkel & Kogan, 1994: 51)

In response to those doubts, the Winfield Report (1987) launched an inquiry into the submission rates of social science PhD. With regard to the purpose of doctoral study, it finds that "the absence of a research-based literature on doctoral study may have contributed to the apparent uncertainty about the nature. form and purpose of the degree. The purpose (or purposes) of the PhD have not been set down in such a way as would attract unequivocal and widespread agreement." (ibid.: 11) It points out the need to consider doctoral study in its "educational, social or political context" (ibid.:11) In a similar vein, the guidelines for postgraduate training by ESRC, maintain that the main purpose of research training provision is to produce "a trained researcher". (1991: 2)

On the other hand, the CVCP has a more conventional view about doctoral education. (Becher, Henkel & Kogan, 1995: 10) Vice-chancellors maintain that the "essential nature and purpose of the PhD" consists in "enabling young people of the highest intellectual ability to develop ... originality, and to make a positive contribution to knowledge and creativity in their respective disciplines." (CVCP, 1983 in Becher, Henkel & Kogan, 1994: 52; 1995: 10) Although they retain a more restricted orientation to the PhD, "the unpredictability of original work" is also recognised. (CVCP, 1987 in Becher et al., ibid.) For pursuing originality of the knowledge, the training in research methods and foundations for an independent research career are taken into account in doctoral education. (CVCP, 1975; 1987; 1988 in Becher et al., 1994: 52)

In the most recent inquiry by HEFCE, the Harris Report (1996), the purposes of postgraduate education are broadly defined by its private and public roles. In its private role, "pg education in all its forms serves the needs of individuals, it stimulates their minds, and enables them to learn new skills and acquire new knowledge, and to develop intellectual and cultural appreciation – and by all these means to enhance their chances of a rewarding and personally satisfying life." (ibid.: 15) In the public role, "pg education contributes directly to wealth creation. Pg study remains a

principal vehicle for the development of the next generation of some of the best minds of the nation working at the forefront of their subjects and carrying the research of the country forward." (ibid.)

Having recognised the aspects of individual development and research training in postgraduate education, the balance is slightly tilted towards research knowledge when doctoral education is concerned. For example, "we recommend to HEFCE: that it should limit its provision of funds in its research model in respect of pgr [postgraduate research] students to departments or comparable units which have achieved a rating of grade 3 or above in the most recent RAE, or which demonstrate the capacity to obtain significant research grants." (ibid.: 56) This line of reasoning suggests that research education is currently recognised as an important source of highly qualified labour force in society, but research councils are seen to "limit such extensions of the purposes of doctoral degrees." (Becher et al., 1994: 52-53) While this is the case from the official point of view, there are changes under way in doctoral education in UK universities that are worth noting.

4.2 Transformation of Doctoral Education in UK Universities

The major changes in British doctoral education in the past two decades can be discussed in three aspects: research training, nature of PhD study and the link between research and society. The important concepts in each respect are summarised in Table 4-1.

During the past twenty to thirty years, research training has become more formalised. For example, in the past, research students were mainly led and learning from their own supervisors in a traditional apprenticeship model. With the growing concern of poor completion rate in social science especially in 1980s (Rothschild, 1982; Rudd, 1985; Winfield, 1987) and with the influence from North America (Burgess, 1994), the Economic and Social Research Council (ESRC) responded by advocating the training-based PhD in 1987. Sixty percent of the first year of the work of doctorate students funded by the ESRC is required to have formal training. This is a big shift in

Table 4-1: Features of the Transformations in Doctoral Education in UK Universities

	From Disciplinary knowledge-focused	To Training-focused
Research training	No formal training	Formalised training
Nature of doctoral study	Generation of new knowledge Admission to academic community A life of scholarship	Vocationalism Training process Independent researcher
Research and society	University-led research	Industrial/ sponsor-led research Economy development PhD as a labour force qualification

(source: compiled by the author from the materials discussed in the text.)

British doctoral education. As Hockey put it, "the radical nature of this new policy can be appreciated if it is realised that the British PhD, unlike its US counterpart, traditionally contained no course work component." (1991: 320)

Research training has been not only formalised but also broadened. Research students are expected to be familiar with all kinds of research methods apart from the one they use in their own theses. For people who argue for greater training inputs, this broadly-based research training provides better transition between undergraduate and postgraduate work (Silk, 1988) and improves employability (Murray, 1988 both cited in Hockey, 1991: 321)

The second feature of the change is about the nature of PhD study. In the past, PhD study meant choosing an academic career. The majority of PhD graduates would remain working in universities or in academic surroundings. The PhD degree was perceived as an admission to academic community and a life of scholarship. (Blume, 1986: 221) For this reason, PhD work was essentially focused on the generation of new knowledge. The originality of the work became the major or only criterion in judging the candidate.

With the increasing numbers of PhD students and growing concern for their employability during the last decade, the perception of the nature of PhD study has

changed. Although PhD students are still expected to work at the front line of knowledge, the training process and the link between PhD study and the labour market are also emphasised. PhD training is becoming more structured and market-driven. It emphasises students' employability in order to meet broader market needs. Blume (ibid.) describes this change as vocationalism. The concept of vocationalism can be developed further. The nature of PhD study has shifted from the representation of academic knowledge to the production of societal and market value. PhD graduates are expected to be 'professionally trained researchers' (ESRC, 1996 cited in Collinson, 1998) rather than merely academic scholars.

This feature of vocationalism of doctoral education also reflects the link between research and society. In the Harris Report, the effective link between postgraduate education and social needs is stressed. (1996: 15-29) When, in the past, universities had greater autonomy and more adequate funding, their research was mainly led by the academic community. More recently, the decline of central funding and the call for greater accountability confront university research with the needs of the economy, industry and a wider "user community" (Burgess, Band & Pole, 1998: 142), particularly in science subjects. The concern for the link between academic research and industry manifests itself when industrial 'users' are invited to be members of the Science and Engineering Committee and to be involved in the decision making of the academic research in 1982. (Swinnerton-Dyer, 1982: 235). The direct influence of this on research students is the distribution of the studentships. Students' research is more likely to be funded if it is undertaken in industrial and commercial settings, such as the "Co-operative Awards in Science and Engineering (CASE)" and the "Parnaby scheme" (Burgess et al., op. cit.: 148).

The growing concern of the national interest and the link between academic research and the needs of industry and commerce change the way PhD study is perceived, especially in science subjects. PhD students are more likely to be regarded as highly qualified manpower in the labour market rather than simply as academic researchers. With more involvement from industry or 'users', more industrial-focused doctorates are produced. It suggests that university research is losing its autonomy. The priority of research based on fundamental knowledge is challenged. On the other hand, this change improves the employability of PhD graduates. It takes students beyond

academic or academic-related research. It opens more doors for students who have other life plans.

From the above discussion, it is noticeable that a new trend of doctoral education has emerged. The focus of doctoral education has moved from disciplinary-knowledge-based to more broadly training-based. This change echoes the "Mode 2" knowledge discussed by Gibbons et al. (1994). Gibbons et al. distinguished two different types of knowledge production, Mode 1 and Mode 2. Gibbons (2000) summarises these two Modes as follows:

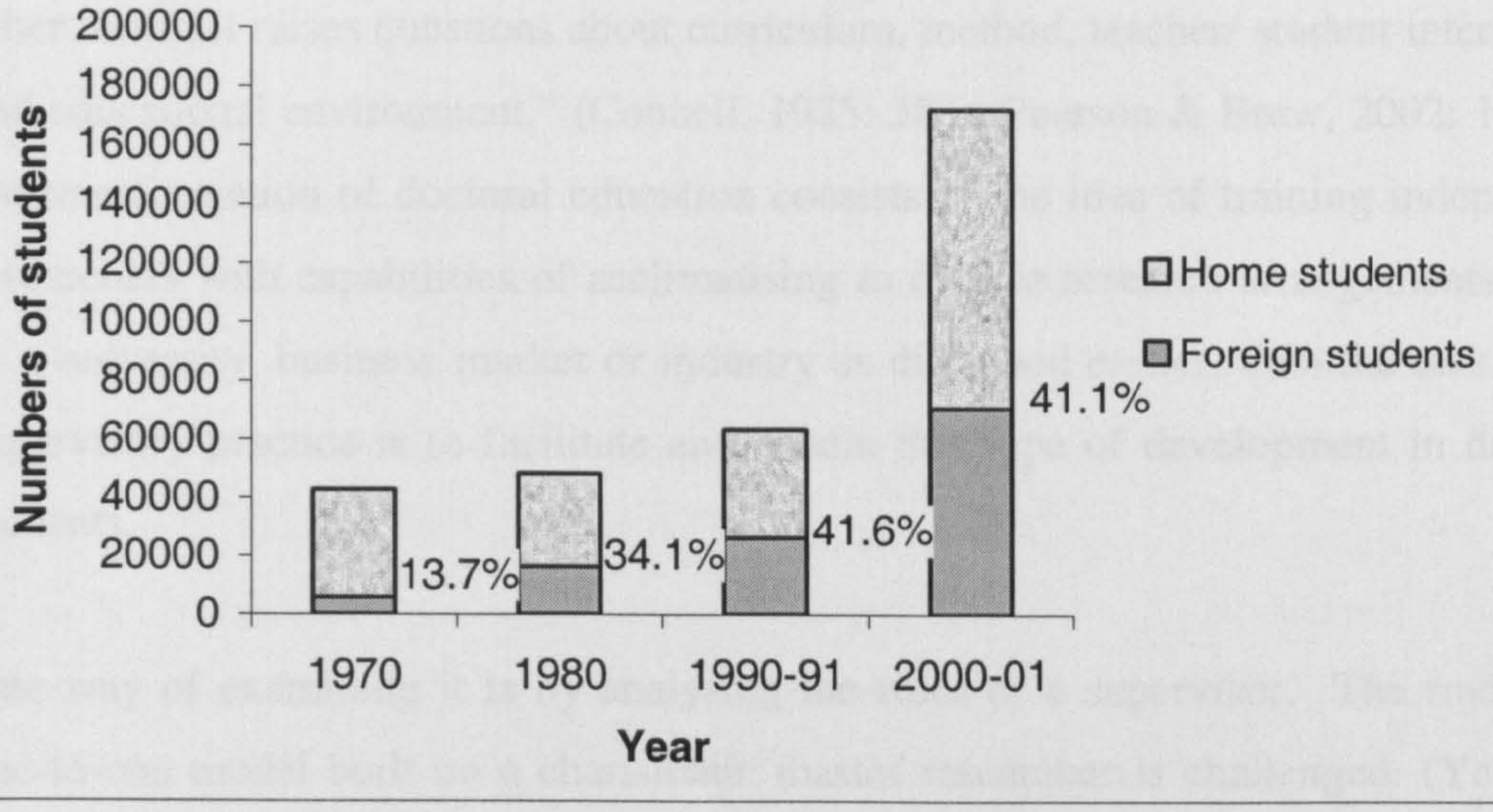
> - in Mode 1, problems are set and solved in a context governed by the, largely academic, interests of a specific community. By contrast, in Mode 2, knowledge is produced in a context of application involving a much broader range of perspectives;
> - Mode 2 is transdisciplinary, not only drawing on disciplinary contributions but can set up new frameworks beyond them; it is characterised by heterogeneity of skills, by a preference for flatter hierarchies and organisational structures which are transient. It is more socially accountable and reflexive than Mode 1.
>
> (Gibbons, 2000: 159-160)

According to this theory, Mode 1 is known as traditional knowledge, which is generated in disciplines and is academic-driven. In contrast, Mode 2 knowledge is produced out of wider interests. It is usually driven by the needs or problems rising outside the academia, such as social and economic concerns. The application side of the knowledge therefore is stressed. (Gibbons et al., 1994; Gibbons, 2000) The changes that the doctoral education is undergoing correspond with this Mode 2 knowledge. Doctoral education becomes more formalised, training-based and market driven. PhD students are expected to specialise in one area but at the same time have broader understanding about the general subject and research methods.

Furthermore, the number of overseas students also significantly increased during the past three decades as shown in Figure 4-1. (Unfortunately, the University Grants Committee and the University Funding Council did not distinguish Masters and PhD students.) In 1970, there were 42,820 full-time postgraduate students in the UK. (University Grants Committee, 1973: 2-3) Among them, 5,886, or 13.7% of them, were from foreign countries. In 1980, the total full-time postgraduate students were 48,439 and 34.1% of them, or 16,533, were from foreign countries. (University Grants

Committee, 1982: 12-13) In 1990-91, among 63,505 full-time postgraduate students, 26,416, or 41.6% of them, were foreign students. (University Funding Council, 1992: 31) In 2000-01, according to Higher Education Statistics Agency (HESA, 2002), the total numbers of full-time postgraduate students rose to 172,285 and 70,735, or 41.1% of them, are foreign students. Moreover, among the total, 52,801 of them actually pursue "research route of postgraduate study" (means MPhil and PhD students) and more than two fifth of them (42.9%) are from foreign countries. (HESA, ibid.: 37) The increase of foreign students can also facilitate the above transformation in doctoral education.

Figure 4-1: Proportions of Foreign Students in Postgraduate Education in the UK from 1970 to 2001



(source: compiled by the author from the materials discussed in the text.)

The transformation under way in the current doctoral education reveals a further flexibility in the notion of 'teaching' in doctoral education: formalised research training and vocationalist aspects of doctoral education are accentuated. In contrast to the past, doctoral students are more likely to be involved in the market place: they are perceived as a type of labour force and expected to be independent researchers with wide knowledge of research methods. It is in this context that I will further discuss research in doctoral education, suggesting the appropriate measure of teaching in the questionnaire in Chapter Five.

4.3 Research into Doctoral Education

It is not easy to validate teaching effectiveness since there is no single criterion of effective teaching. (Marsh, 1987: 285) In the light of discussion on the transformation of current doctoral education, teaching in doctoral education can be examined from two angles: supervision at the individual level and research environment for students at the aggregate level.

To begin with, it is difficult to define what supervision means in practice especially in the context of transformation. Although both supervisor and doctoral students are engaged in research, the relationship between them is different from the one between academics who are also doing research. "It has to be seen as a form of teaching. Like other forms, it raises questions about curriculum, method, teacher/ student interaction, and educational environment." (Connell, 1985: 38 in Pearson & Brew, 2002: 139) If the transformation of doctoral education consists in the idea of training independent researchers with capabilities of acclimatising to diverse research arrangements either in a university, business market or industry as discussed earlier, then the task of the supervisory practice is to facilitate and ensure this type of development in doctoral students.

One way of examining it is by analysing the roles of a supervisor. The traditional one-to-one model built on a charismatic master researcher is challenged. (Yeatman, 1995 in Johnston, 1999: 23) It has been argued that in order to best foster their students, a wide range of different roles should be undertaken by the supervisor. As discussed in section 2.2.3, Bennett and Knibbs (1986) identify four types of supervisory roles: process, academic, interpersonal and validation. Phillips and Pugh discover nine. (1987) Ten roles of the supervisor are distinguished, including director, adviser, facilitator, teacher, guide, critic, supporter, friend, manager and examiner in Brown and Atkins (1988).

Furthermore, certain facets of the supervisory relationship are accentuated. Elton and Pope (1989) highlight the value of collegiality in the supervision. They argue that research students are adult learners who "have a right to and can benefit from

autonomy in their learning." (ibid.: 270) In a similar vein, Evans and Pearson (1999) contend that the teaching role of the supervisor combines both mentor and 'master' (as in master and apprentice). The supervisor is

> a 'critical friend' guiding the 'student' through the scholarly maze to the doctoral examination and graduation. Or maybe a 'gate-keeper of science' ... who ensures that the 'student' completes all the necessary conditions before entry.
>
> (Evans & Pearson, ibid.: 196 in Pearson & Brew, op. cit.: 139)

The value of authenticity and trust is also emphasised. "Effective supervision is built on a foundation of trust." (McBride & Skau, 1995: 267)

Another way of looking at it is by illuminating the difficulties facing doctoral students. At the individual level, impeding factors in the four areas as discussed in section 2.2.3 emerge from a voluminous literature: each respectively concerns supervisor-student relationship, knowledge, communication/ access and empowerment, as shown in Table 2-4 (Appendix 14). With regard to the supervisor-student relationship, research has shown two major difficulties facing doctoral students' learning: negligent supervision (Schon, 1987 in Hockey, 1991: 327; Connell, 1985: 38 in Pearson, 1999, 276) and negative exploitation of doctoral students' efforts and ideas (Brown & Atkins, 1988: 117; Nelson, 1995; Clark, 1993: 139). The latter entails imbalance of power. (Becher et al., 1994: 148) The former concerns issues such as ethics of supervisors (Stacy, 1999: 88-80), personality match (Wisker, 1996: 142-143), lack of a sense of being valued as a person (Becher et al., op. cit.: 144), marginalisation (ibid.: 148), issue of autonomy (Johnson et al., 2000: 137) and unconcerned supervisors (Aspland & O'Donoghume, 1994: 66-69).

Research also reveals that factors influencing doctoral students' learning in relation to supervisor's knowledge include deficiency of supervisor's guidance (Hockey, 1991: 326; Maor & Fraser, 1995: 7; ABRC, 1982 in Burgess et al., 1995: 140), supervisors' limited expertise in student's research area (Geake & Maingard, 1999: 55; Heath, 2002: 50), supervisor's ensuring a promising topic (Becher et al., 1994: 100; Wisker, 1996: 140, 142) and supervisor development (Pearson & Brew, 2002: 143-148).

With regard to communication/ access issues, the major impeding factor is supervisor availability. (Becher et al., 1994: 144-145; Channell, 1990: 70-73; Pole et al., 1997:

60-61; Heath, 2002: 50) As for empowerment, factors hindering doctoral students' learning are attrition (Phillips, 1980 in Hockey, 1991: 325; Noble, 1994: 26; Clark, 1993: 141) and loneliness (Rudd, 1975: 86-106; Burgess et al., 1995: 141; Clark, 1995: 137-138).

At the aggregate level, several studies have established the importance of institutional factors with student achievement. Terenzini et al. (1984) find that the development of student's academic skills is a result of "collegiate experience". In the collegiate experience, the "Faculty Relationship" factor plays an important role through both the frequency and quality of the contacts. (ibid.: 634) In another study, Volkwein et al. discover that when background and experiential variables held constant, "students' perceptions about the *quality* and strength of their relationships with faculty are significantly associated with two measures of intellectual growth." (1986: 425) In a similar vein, Astin shows that peer group has a significant effect on student's development. (1993: 363) Academic orientation of the staff also contributes to student's educational experience. "Attending a college whose faculty is heavily Research-oriented increases student dissatisfaction and impacts negatively on most measures of cognitive and affective development." (ibid.) Students who attend a college which focuses on student development have the opposite pattern of effects.

In doctoral education, Wright and Lodwick (1989) demonstrate the importance of the academic network for students. The opportunities for academic interaction are stressed as they foster collegiality leading to compensate for the academic isolation of the independent research. Their research points out that one of the mechanisms to establish academic networks for students is the "rooms to meet and work in department". (ibid.: 45-46) The other is formal training programme which involves research seminars, research training courses and external seminars or conferences. (ibid.) They found that doctoral learning takes place with debate and interaction, not with total isolation. (ibid.: 54) They also found that compared with home students, overseas students are "at a disadvantage in this respect." (ibid.: 46) It indicates that "none of the overseas students in the survey had *regularly* attended external seminars or conferences, and 35 per cent did not attend any in their first year." (ibid.) The reason, according to them, is that it takes time for overseas students to know "how the 'system' works within their departments, let alone in other universities." (ibid.)

It is echoed by other studies. For example, Girves and Wemmerus discover that academic integration "is directly related to doctoral degree progress." (1988: 185) The academic integration or "involvement" entails financial support and student/ faculty relationship. Nerad and Cerny (1993) find that departments having shorter completion time of PhD study are those where students are treated as junior colleagues and integrate into the social and academic activities of the department. (in de Valero, 2001: 345)

This topic can also be illustrated by studying the doctoral completion time. Tuckman (1991) reports that the total time to the doctorate (TTD) rose sharply after 1970 in each of the fields in the study. For the 1967-1986 period, TTD on the average rose 2.8 years in the social sciences, 2.4 years in the sciences, and 2.1 years in math and computer sciences. (Tuckman, Coyle & Bae, 1989 in Tuckman, ibid.: 226) The time registered in graduate school also increased 2.9 years in the social sciences, 1.9 years in economics, 1.6 years in earth/atmospheric/marine sciences and psychology, and math and computer sciences, and 1.2 in the agricultural sciences from 1967-86. (ibid.: 227) The rise of completion time can be caused by many reasons. Among them, the institutional factor as an involuntary source is emphasised. Tuckman demonstrates that "it is sufficient to note here that the way that a student is treated at an institution affects the pace at which he or she completes a doctorate." (ibid.: 245) Tuckman raises questions pertaining to the role of institution in doctoral students' learning. For example, whether universities are effective and efficient in carrying out the goals of graduate education. It is argued that the rise of completion time is due to the fact that institutions fail to offer sufficient guidance and support to students and fail to adequately prepare students up for the demands of the thesis. (ibid.: 249)

Similar results are found in Lovitts and Nelson (2000) and de Valero (2001). The survey of Lovitts and Nelson indicates "a high correlation between integration into a department's social and professional life (becoming part of the community) and successful completion of the PhD." (op. cit.: 47) Confirming the findings of Wright and Lodwick (op. cit.), they point out the importance of having an office sharing with other students leading to a sense of community, resolving isolation and exchanging informal knowledge. This informal knowledge, according to them, is crucial for

completing a PhD program because "the department's official public face has to be supplemented by the advice people will offer in person but not on paper." (ibid.) They also find that "students who receive no financial support have the lowest level of participation and are the most at risk of withdrawing from the program." (ibid.: 47)

Some people may argue that the way to improve student success is by admitting better students. However, evidence found in Lovitts and Nelson's study shows that "students who persist and students who leave are equally well qualified." (ibid.: 49) No significant difference is found between undergraduate academic grades averages of the students who did complete the PhD and those who did not. They contend that "the real problem is with the character of graduate programs rather than with the character of their students." (ibid.) It is concluded that "a student who enters a department whose culture and structure facilitate academic and personal integration is more likely to complete the PhD than a student whose departmental culture is hostile or laissez-faire" and "a student invited into the department's academic and social community is more likely to succeed than a student left entirely to his or her own resources." (ibid.: 50)

de Valero (2001) clusters four types of institutions: (1) High completion rate (CR) and short time-to-degree (TD); (2) Low CR and short TD; (3) High CR and long TD; (4) Low CR and long TD. He finds that participants (both academics and students) in the departments with high CR and short TD as in the first group acknowledge that student success is related to departmental orientation and advising. Those departments are also characteristic of other factors such as financial support, relationship between course work and research skills, student participation and peer support. In the comparisons along the two dimensions – time-to-degree and completion rate, it is discovered that firstly financial support and the relationship between course work and research are the factors that differentiate the short-time and long-time-to-degree departments. (ibid.: 360) Secondly, the factors that distinguish high-completion and low-completion-rates departments are departmental orientation and advising, and attitudes towards students. (ibid.: 361)

On the other hand, Deem and Brehony (2000) investigate the issue from the perspective of research culture. Three types of research culture are identified:

research student culture, research training culture and academic research culture. It is found that "international students and part-time students have the most difficulty in accessing peer cultures and academic culture." (ibid.: 149) On the other hand, home-based full-time students have the easiest access to them. Other difficulties facing overseas students include problems of integration and marginalisation of foreign students (Veile, 1988) Foreign students live and work in greater isolation than home students. They do not feel valued apart from money concerned. (ibid.: 3) Makepeace points out that certain stereotypes to consider foreign students with special needs leading to patronisation or even racism. (1989: 6)

In brief, the previous research reveals the multiple-dimensions in doctoral education at both individual and aggregate levels. Of particular interest here is how the relationship between research and teaching which has been discussed in Chapter Two manifests itself in this multi-dimensional doctoral education.

4.4 Previous Empirical Findings of Research/ Teaching Relationship at Doctoral Level

Unfortunately not many empirical studies of the relationship between research and teaching have been carried out at the doctoral level. Two main studies were found: Kyvik & Smeby, 1994; Fox, 1992. Kyvik and Smeby (1994) is the only study targeted specifically at doctoral education. The study of Fox (1992) which was reviewed in section 3.2.1 focuses on different levels of university teaching and has a special section on doctoral education. Both of them are correlational studies. (Table 4-2)

Regarding the relationship between research and teaching in doctoral education at the individual level, Kyvik and Smeby (1994) highlight the importance of PhD supervision in staff research performance. They sent questionnaires to all senior academics with a rank of assistant professor or higher across different disciplines at four universities in Norway in 1992. The purpose of their study is to examine the relationship between the supervision of doctoral students and staff's research performance. The respondents were asked to report their research publications in a

three-year period 1989-91. They were also asked to self-assess the relationship between supervision of PhD students and their research.

At the individual level, it was found that "there is a positive correlation between the number of graduate students faculty supervised and productivity (Pearsons r = .22)". (ibid.: 235) They also found that PhD supervision is a major predictor of staff research performance in natural, medical sciences and technology, but not in humanities and social sciences.

Table 4-2: Correlational Studies on Research and Teaching in Doctoral Education

Empirical study	*Author / Year*	*Research methodology / Sample*	*Findings*
Teaching and Research. The Relationship between the Supervision of Graduate Students and Faculty Research Performance	Kyvik & Smeby, 1994;	• Questionnaires: all faculty member of assistant professor or higher in 4 universities Self-report of research productivity and supervision. • Subject: Humanities, Social Sciences, Natural Sciences, Medical Sciences and Technology • Country of study: Norway	• "There is a positive correlation between the number of graduate students faculty supervised and productivity. (Pearsons r = .22)" "More PhD students and more tenured faculty in their own field were most important" to improve the professional milieu in the department. • Disciplinary differences: "A larger part of the faculty in the natural sciences, medicine and technology reported that more PhD students is of great importance, than in the humanities and especially in the social sciences." "The supervision of PhD students has an independent effect on faculty members' research performance in the natural and medical sciences and technology, but not in the humanities and social sciences."
Research, Teaching and Publication Productivity: Mutuality Versus Competition in Academia	Fox, 1992	• Questionnaire: 3,968 academic staff. Self-reported research assessment and 'teaching investment'. • Subjects: Social science faculty (Economics, Political Science, Psychology & Sociology) • Country of study: US	• Negative (regression coefficients) For faculty in PhD departments, the relationship between research and teaching "is weaker (R^2=.163) than for faculty in BA or MA departments." • Disciplinary differences: (not identified)

r: Pearson's r.
p: p value or significance level.

Next, with regard to staff's enjoyment of different tasks, they found that "staff liked supervision better than teaching, but were less content with supervision than with doing research." (ibid.: 232) This applies to all disciplines involved in the study.

Furthermore, 49 percent of staff who have PhD students regard the PhD supervision "to a great extent" as part of their own research. (ibid.: 234) This finding greatly varies among disciplines. The proportions of staff who hold the above view in natural sciences, medicine and technology are almost three times more than those in social sciences and humanities.

At the aggregate level, they found that 43 percent of staff think that "more PhD students could improve the professional milieu in their department to a great extent." (ibid.: 233) In contrast, 41 percent of staff prefer to have more tenured faculty than PhD students in their own field. "This indicates clearly the importance faculty put on PhD students as a milieu factor." (ibid.) This finding also varies among disciplines. They found that "a larger part of the faculty in the natural sciences, medicine and technology reported that more PhD students is of great importance than in the humanities and especially in the social sciences." (ibid.) Moreover, staff in the natural sciences, medicine and technology perceive PhD students as having greater importance than tenure faculty in the department. In contrast, staff in the humanities and social sciences perceive the other way round.

From another angle, Fox (1992) investigates the link between research and teaching by examining how the teaching and research investments of staff relate to their publication productivity. With regard to doctoral education, Fox found that publication productivity is positively related to research-concerned activities and negatively related to teaching-concerned activities:

> For faculty in PhD departments, likewise, the signs of the variables are in the same direction – positive for research, negative for teaching – indicating non-complementarity here as elsewhere.
>
> (Fox, ibid.: 300)

However, compared with BA or MA departments, the above finding for PhD departments is weaker. It is concluded that "the teaching and research patterns are

maintained and point to the competition between, rather than the complementarity of activities." (ibid.: 301) Disciplinary variation is not mentioned.

4.5 Brief Evaluation of Previous Works at Doctoral Level

Since very few empirical studies were carried out, leading to the uncertain evidence of the link between research and teaching at the doctoral level, the findings are highly inconclusive. By reviewing the two studies in doctoral education, it seems to suggest that although PhD supervision is important for staff research especially in the natural sciences and medicine, staff's investment in supervision may still be in conflict with the investment in their own research. However, these findings are far from certain and conclusive. We have at present no way of knowing whether the findings of Kyvik and Smeby (1994) and Fox (1992) will remain the same, first, if students' views are taken into account; second, if disciplinary variation is considered in Fox (ibid.). In addition, the contradictory findings between disciplines of sciences and social sciences, between correlational and exploratory researches, between data obtained from students, younger academics and senior staff as discussed in sections 3.2.1 and 3.2.2 also call for further investigation.

Chapter Five

Empirical Research Strategy

This chapter will begin by explaining the choice of subjects in my fieldwork. It then goes on to discuss the major research strategy, measures of research and teaching and how the empirical part of this research was carried out. Finally, it explains how the interview data was collected.

5.1 Choice of Subjects

The issue of the similarities and differences of subject matters in various academic areas has been widely explored. At least six models have been developed over the course of the twentieth century. To begin with, Snow (1959) divides the academic subjects into two cultures: artistic and scientific. These two cultures, according to Snow, are incommensurable. (ibid.: 16) Literary intellectuals in the artistic group, for example, cling more to 'traditional' culture. On the contrary, scientists are more optimistic and future oriented. In religious terms they are more likely to be unbelievers. These two cultures have hostile feelings about each other.

In the second model, according to the results of his psychological tests of intellectual abilities, attitudes and personalities, Hudson (1966) distinguishes two types of learners: the converger and the diverger. Convergers are those who are significantly good at intelligence tests, while divergers are those good at open-ended tests, which are regarded as the yardstick for creativity (Getzels & Jackson, 1962 in Hudson, ibid.: 35-41). He found that most professionals of arts and humanities are good at open-ended tests; most scientists are good at IQ tests. In other words, artistic professionals are more likely to be divergers; scientists are convergers. He also found that it is easier for arts subjects, such as history, English literature and modern languages, to attract divergers and for science subjects, such as mathematics, physics and chemistry to attract convergers. (ibid.: 25-27)

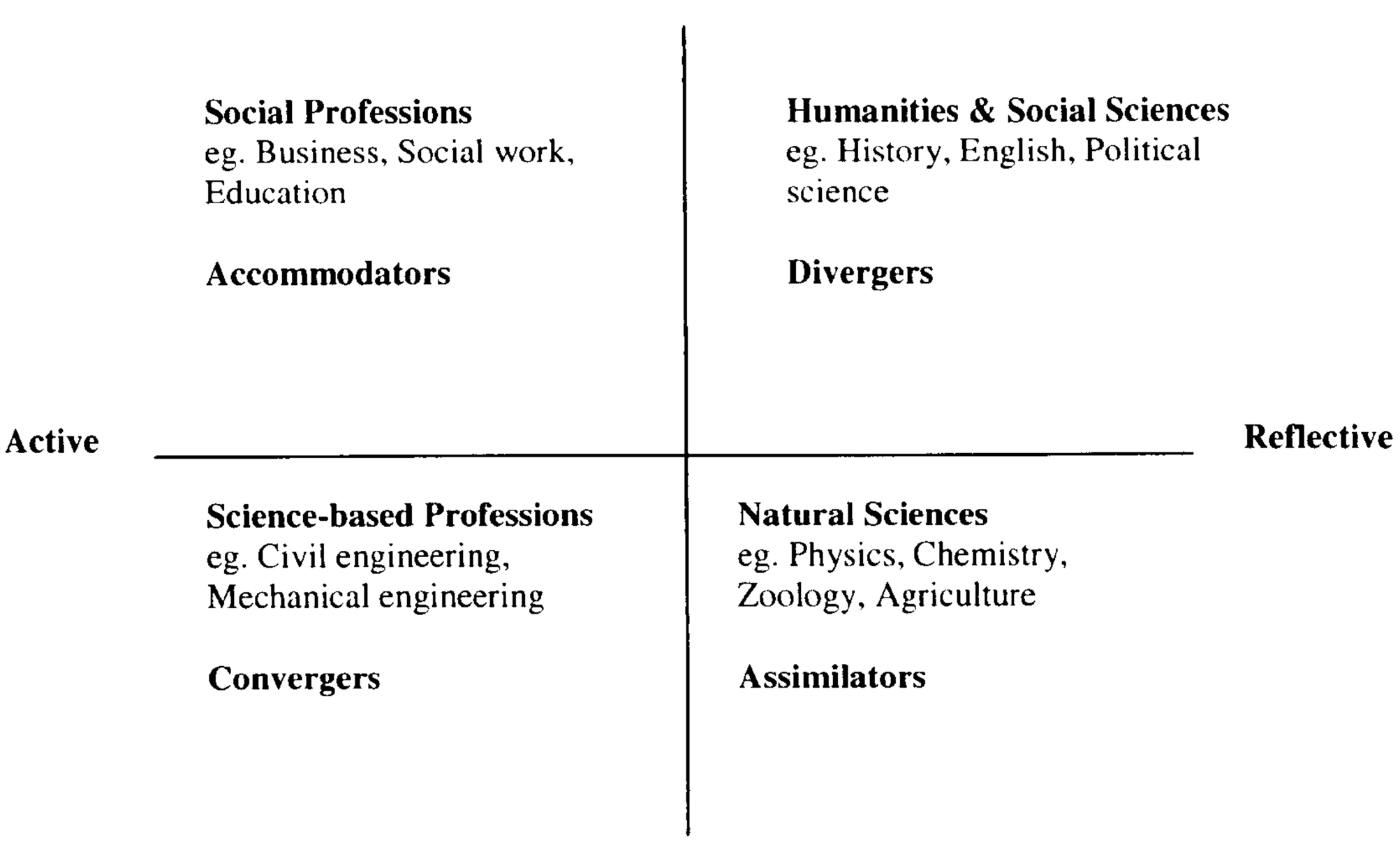
The third model is based on Kuhn's idea of the paradigm (1962, 1970b). According to Kuhn, the scientific paradigm refers to the consensus and values towards the theories, findings, enquiries and methodologies that are used and legitimised in the field. "...it [paradigm] stands for the entire constellation of beliefs, values, techniques, and so on shared by the members of a given community" (1970b: 175 cited in Lodahl & Gordon, 1972) Compared with the social sciences, Kuhn contends (1962), paradigms in science subjects are more highly developed. In other words, scientists share more consensus and values in the field. In order to test this proposition, Lodahl and Gordon (1972) selected four subject areas: physics and chemistry to represent science; sociology and political science to represent social sciences. A questionnaire was sent to faculty members in eighty university departments: twenty in each subject. It was found that scientists in physics share significantly more consensus of the subject compared with those in political science. This suggests that paradigms in the sciences are more rigidly adhered to than those in the social sciences resulting in greater uniformity of rules and methods among scientists.

The next is Biglan's three-dimension model. (1973a, 1973b) Biglan conducted empirical research involving 168 scholars at the University of Illinois and another 54 scholars at a small college to elicit their opinions about thirty-six academic areas. The findings from both the university and the small college reveal three characteristics of academic subjects. The first dimension is the 'hard / soft' division. According to Biglan, this dimension corresponds with Kuhn's concept of paradigm. The "hard" academic areas, which are also highly paradigmatic in Kuhn's term, are the science subjects. Social science subjects and the humanities are regarded as being less paradigmatic or as 'soft'. The second dimension concerns the applicability of the subject knowledge: 'applied / pure'. According to Biglan, "scholars in applied areas like to work with significantly more people on teaching than do scholars in pure areas. Similarly, applied area scholars like to work with more people on research than do those in pure areas. And they report more sources of influence on their research goals than do the pure area scholars." (1973b: 209) Subjects like education, engineering and agriculture are situated in the applied area, whereas subjects like physics, literature and sociology are located in the pure area. The third dimension is 'life/ non-life' system. Subjects like biology and social sciences are included in the life system

due to their dealings with animate matters, while subjects like mathematics and languages are in the non-life system due to their dealings with inanimate or abstract objects.

The fifth model is based on Kolb's concept of the experiential learning style. (1981) Kolb examined data collected by the Carnegie Commission on Higher Education (1969) study of American colleges and universities. The data was composed of 32,963 questionnaires from postgraduate students in 158 institutions and 60,028 questionnaires from academic staff in 303 institutions. Kolb found that there are two distinctive dimensions: abstract–concrete and active-reflective. Based on these two dimensions, four discipline areas and four types of learning styles are distinguished. The combination of all these elements (ibid.: 237-239 and his original Figure 2, 3, 4 in 1981: 240-242) is presented in the Figure 5-1.

Figure 5-1: Kolb's Model of Disciplines



(a combination of Kolb's Figure 2, 3, 4 in 1981: 240-242 and 237-239)

In the first abstract-concrete dimension, Kolb uses 'concrete' to indicate "*Concrete Experience* abilities" (original italics, ibid.: 236), meaning that "they [learners] must be able to involve themselves fully, openly, and without bias in new experiences.

'Abstract' is used to indicate "*Abstract Conceptualisation* abilities" which means that "they [learners] must be able to create concepts that integrate their observations into logically sound theories." (ibid.) In the second active-reflective dimension, 'active' stands for "*Active Experimentation* abilities", meaning that learners "must be able to use these theories [generated by Abstract Conceptualisation abilities] to make decisions and solve problems." (ibid.) On the other hand, 'reflective' means "*Reflective Observation* abilities": learners "must be able to observe and reflect on these experiences [Concrete Experiences] from many perspectives." (ibid.)

First of all, subjects of natural sciences and mathematics such as physics, chemistry, zoology and agriculture lie in the abstract/ reflective quadrant. Academic staff and students in this area are more likely to be assimilators who are characteristic of their abstract conceptualisation and reflective observation. They excel in the ability to create theoretical frameworks. Next, subjects of science-based professions such as civil engineering and mechanical engineering cluster in the abstract/ active quadrant. This quadrant features the convergent learning style. According to Kolb, convergers, in corresponding to Hudson (op. cit.), are good at abstract conceptualisation and active experimentation. They are good at practical application of ideas through "hypothetical-deductive" reasoning and seem to perform best in intelligence tests. Divergers, who are opposite to convergers, are strong on concrete experience and reflective observation. They are in the concrete/ reflective quadrant incorporating subjects of humanities and social sciences such as history, english and political science. Imaginative ability is their strength. They are good at perceiving "concrete situations" from different viewpoints and organising different relationships into a "meaningful 'gestalt'". (ibid.: 238) The last one is the concrete/ active quadrant which consists of subjects in Social Professions such as business, social work and education. They are accommodators in their learning style. In contrast to assimilators, accommodators' strengths lie in concrete experience and active experimentation. They excel in the ability to adapt to "specific immediate circumstances". (ibid.) They are "action-oriented". (ibid.)

The sixth model is developed by Becher (1984, 1987a, 1987b, 1989). Becher elaborates two dimensions of Biglan's model: 'hard-soft' and 'pure-applied'. Based on it, he groups disciplines into four categories: (1) Pure science as 'hard/ pure' (e.g.

physics); (2) Humanities (e.g. history) and Pure social sciences (e.g. anthropology) as 'soft-pure'; (3) Technologies (e.g. mechanical engineering) as 'hard-applied'; (4) Applied social sciences (e.g. education) as 'soft-applied'. (1987a: 278, 289) These four disciplinary areas were then analysed in terms of the nature of knowledge and disciplinary culture.

In this research, two disciplines are selected: Chemistry and Education. Their corresponding categories in the six models are listed in Table 5-1.

Table 5-1: Chemistry and Education in the Models of Disciplinary Analysis

Six Models	Chemistry	Education
Snow's Model (1959)	• Scientific	• Artistic
Hudson's Model of Way of Thinking (1966)	• Converger	• Diverger
Model of Lodahl & Gordon on Paradigm (1972)	• High paradigm	• Low paradigm
Biglan's Three-dimensional Model (1973a, 1973 b)	• Hard • Pure • Non-life	• Soft • Applied • Life
Kolb's Model of Learning Style (1981)	• Natural science & mathematics • Assimilator Abstract Reflective	• Social professions • Accommodator Concrete Active
Becher's Model of Nature of Knowledge and Communication (1984, 1987a, 1987b)	• Knowledge Cumulative • Communication Collaboration	• Functional • Individuation

5.1.1 Chemistry

Chemistry is categorised in the scientific culture in Snow's model; as 'hard/ pure/ non-life' system in Biglan's; as part of natural sciences and mathematics in Kolb's. In terms of learning style, Chemistry is characteristic of convergers (Hudson, 1966) and assimilators (Kolb, 1981). Hudson's research shows that convergers are likely to conform and to be conservative. Compared to divergers, they are more likely to

conform to traditional values, accept expert advice and work as good team members; less likely to approve of being highly imaginative and artistically sensitive; more interested in impersonal aspects of culture, and more cautious of expressing feelings. (Hudson, 1966: 67-68, 85-90) In Kolb's model, chemists tend to be assimilators. They are good at abstract conceptualisation and reflective observation. They shine at inductive reasoning and in the creation of theoretical models.

From the perspective of knowledge, Chemistry as part of pure science is characterised by its cumulative nature. (Becher, 1984, 1987a, 1987b, 1989) According to Becher, the hard-pure knowledge develops like a tree. (1987a: 280) Compared with soft-applied knowledge, it is concerned more with quantities, regularities and reductive way of thinking; it tends to be more impersonal and value-free. It aims at discoveries and explanation. The clear boundary of its knowledge (Becher, 1984, 1987a, 1987b) and great consensus among members on the values, theories, methodology, techniques and problems make Chemistry a "high-paradigm" subject. (Lodahl & Gordon, 1972) Moreover, Chemistry as a part of the natural sciences and mathematics, stresses integrative analysis and structures. (Kolb, 1981) Its knowledge, according to Kolb, is depicted in symbols and models. The basic inquiry question is 'what'.

In terms of communication and exchange of ideas, Becher's research reveals that Chemistry, a hard-pure subject, is characterised by fierce competition. (1984, 1987a, 1987b, 1989) In order to catch up with the latest development, communication channels and groups are prepared for exchange and advancement. (1987a: 285) The hard-pure subjects as "the most highly developed fields have the most efficient communication processes to speed development still further." (Lodahl & Gordon, 1972: 70) Accordingly, Becher found that Chemistry has a high publication rate. (1987a: 286-287, 1989: 85) In organic Chemistry, for example, papers of research findings may only have three or four pages with three or four authors, but an applicant for a university post at the age of thirty might be required to have about forty publications. (Becher, 1987a: ibid.) In the same light, Biglan's research found that fewer monographs and more journal articles are published in hard or highly paradigmatic areas, Chemistry among them, than in soft or non-paradigmatic areas. (1973b: 211) The reason, according to Biglan, is that in highly paradigmatic areas,

scholars are so familiar with descriptions of the content and method underlying a piece of research that there is no need to repeat them in the paper. (ibid.) Owing to this, journal articles with their constraint of length become a popular way to communicate. Due to the large scale and high cost of research, scholars in hard areas tend to be more involved in teamwork and collaboration than in soft areas. (Becher, 1987a: 287-288, 1989: 95-97)

5.1.2 Education

A contrast to Chemistry is Education. Education can be regarded in the artistic area in Snow's model; as a 'soft/ applied/ life' system in Biglan's; as part of the social professions in Kolb's. To begin with, and from the viewpoint of learning style, Education is characteristic of divergers (Hudson, 1966) and accommodators (Kolb, 1981). In contrast to convergers, Hudson's research shows that divergers are characterised by liberal and non-authoritarian attitudes. "Divergers are more likely to hold attitudes shared by only a minority of their peers". (Hudson, 1966: 64) They are more concerned about the humanistic side of the society and more willing to express their personal feelings. (ibid.: 64-66, 90-93) Furthermore, accommodators, Educationists among them, according to Kolb's theory, shine at concrete experience and active experimentation. They are action-takers who are good at adapting to new or different situations arising from the research. The process usually used by accommodators to solve a problem is intuitive trial and error.

From the perspective of knowledge, Education as part of the applied social sciences is characterised by its functional nature. (Becher, 1984, 1987a, 1987b, 1989) According to Becher, this soft-applied knowledge with less progressive sense and less stability than hard-pure knowledge is based on the continual interpretation of complex human situations. It concerns "knowing how" as well as "knowing that". (Becher, 1987a: 280) With a strong utilitarian orientation, accordingly, it stresses the enhancement of [semi-] professional practice. (ibid.: 278) This soft-applied knowledge with little consensus among members on the values, theories, methodology, techniques and problems makes Education a "low-paradigm" subject. (Lodahl & Gordon, 1972) Moreover, Education as a part of the social professions emphasises discrete synthesis

and pragmatism. (Kolb, 1981) Its knowledge, according to Kolb, is depicted in actions and mainly case study. The basic inquiry question is 'How'.

In terms of communication and exchange of ideas, Becher's research (1984, 1987a, 1987b, 1989) reveals that competition is not so fierce in soft-applied subjects such as Education. The pressure to publish is less and the conferences are fewer than hard-pure subjects such as Chemistry. (Becher, 1987a: 286, 1989: 86) Zuckerman and Merton's study (quoted in Lodahl & Gordon, 1972: 70) finds that social science (low paradigm), next to the humanities (pre-paradigm), has the second highest rejection rates of publication. Compared with Chemistry in a hard knowledge area, writings in Education are more accessible and readable for outsiders. (Becher, 1987b: 268) According to Becher, there are two reasons for this: one is because soft knowledge areas are not subject to a "contextual imperative". (1989: 89) Their research does not take place within a known framework of assumptions. Second is because the legitimacy to public communication is more allowed in soft knowledge areas. The apparatus of research in soft areas are not as complex as in hard areas in terms of scale and cost. (Becher, 1987a: 288) The image of the "lonely scholar" is favoured in this area. (Kleinman, 1983 in Becher, 1989: 97) According to Kleinman, professional development is about "distinguishing oneself from one's peers" and "is synonymous with increasing individuation." (Becher, ibid.)

5.1.3 Disciplinary Variation in the Research/Teaching Relationship

From the above comparison, it is clear that Chemistry and Education are distinct from each other in many aspects. If this is the case, does this disciplinary difference have any bearing on the relationship between research and teaching? In the literature, Smeby (1998) proposes that strong specialisation will hinder the interaction between research and teaching. In hard disciplines, structurally uniform and hierarchical knowledge develops fast, which leads to very specialised research. Hence, soft disciplines such as humanities and social sciences with horizontal development of knowledge and less specialised research will have better integration between research and teaching.

However, this proposition is not supported by Lodahl and Gordon's research. (1972) Lodahl and Gordon found that high-paradigm subjects are in a better position to integrate research and teaching than low-paradigm subjects. Academics in high-paradigm areas, such as Physics and Chemistry, reveal less conflict over time spent with postgraduate students than those in low-paradigm areas. They exhibit more willingness to work with postgraduate students especially. This is because, according to Lodahl and Gordon (ibid.), in high-paradigm areas vocabulary and knowledge are extensively shared between academics and postgraduate students, which leads to better communication and better integration between research and teaching.

This proposition is developed further in another study by Colbeck. (1998) Colbeck distinguishes two types of teaching: classroom-oriented and research-oriented teaching. He found that in classroom-oriented teaching, research and teaching are better integrated in the low-paradigm or soft disciplines. However, in the research-oriented training, they are better integrated in the high-paradigm or hard disciplines. He argues that the lack of consensus about the curriculum in low-paradigm subjects increases the flexibility in designing the course related to staff research areas. Moreover, the flat, expansive and horizontal nature of knowledge in soft disciplines makes it easier to integrate research and teaching in the classroom. In contrast, a "high level of agreement about content and method" together with the accumulative and hierarchical nature of knowledge in hard disciplines makes it harder to integrate research and classroom teaching. (ibid.: 657) On the other hand, in research-oriented teaching, two models of teaching students on how to conduct research are found. A master-apprentice model is adopted for investigating subdividable problems in hard disciplines, while a counsellor model is used in soft disciplines for exploring more holistic issues. Colbeck claims that the master-apprentice model used in hard disciplines provides better opportunities for academics to integrate research and teaching than the counsellor model adopted in soft disciplines. For example, by working collaboratively with undergraduate and postgraduate research apprentices, physicists incorporate research and teaching.

5.2 Survey as the Major Research Strategy

This study combines both quantitative and qualitative research methods. It uses a quantitative survey as the central research strategy and this is supplemented by eight interviews and a literature review, which are much more interpretative in nature, to help explain the survey findings.

The reason for adopting such mixed methods is because "qualitative and quantitative research differ in many ways, but they complement each other, as well" (Neuman, 2003: 139). For example, quantitative research is characterised by its process of deduction (ibid.: 145; Punch, 1998: 240) and generalisation (Brannen, 1992: 8-10; Britt, 1997: 22), while qualitative research is typically associated with its process of induction (Neuman, op cit.; Punch, op cit.) and exploration (Brannen, op. cit.; Britt, op. cit.). Nevertheless, the distinctions between the two approaches are not always clear-cut. Hammersley (1992) argues that the stereotyped dichotomies between quantitative and qualitative research methods "are not as simple or as closely related as is sometimes believed." (ibid.: 40) He contends that "it is more a matter of a range of positions than a simple contrast, that a position on one does not necessarily imply a position on another, and that selection among these positions should depend more on the purposes and circumstances of the research than on philosophical considerations." (Punch, op. cit.: 240)

Therefore, for the purpose of this research, the interview method and literature review are employed to help interpret the findings derived from the quantitative research. "Qualitative research may facilitate the interpretation of relationships between variables." (Punch, ibid.: 247) According to Punch (ibid.), qualitative data is good in shedding light on the factors underlying the general relationships found by quantitative research.

5.2.1 Measure of Research

In order to measure staff research performances across universities and disciplines in the UK, means of measurement which can be applied to both Education and Chemistry are required. It has been assumed that the Research Assessment Exercise meets these requirements.

However, the RAE has received a great deal of criticism. With regard to the RAE and funding, Kushner (1996) argues that the essence of distribution of research funds should focus on facilitating development as a whole rather than favouring a few. "It needs to be developmental *of the whole system* and not just its allegedly 'best parts'." (original italics, ibid.: 6) The result of the RAE means that low-rated science departments find it difficult to attract industry funding. (THES, 21/02/97 in Elkin & Law, 1997: 137)

The RAE is held responsible for having a negative influence on teaching (Broadhead & Howard, 1998) while Stoker contends that "the main outcome of the exercise will be to distract all those involved from fulfilling their core activities of pursuing worthwhile research and good quality teaching." (1996: 5) This point is echoed by Williams: "Individuals who devote much time to teaching may find themselves jettisoned from departments obsessed with the research assessment exercise and that hack back 'dead wood' in favour of those active in research." (1998: 1081) He warns, "this would be catastrophic for the next generation of medical students and for the new-problem based, undergraduate curricula." (ibid.)

The issue of whether the RAE can actually raise the standard of research is also questioned. Stoker (op. cit.) points out the possible distortion of academic publishing caused by the RAE. For example, people may recycle previous work for incautious editors, break down a piece of work into several papers, add their names as joint authors with research students when no contribution is made to the paper, or present speculation or preliminary findings when the whole work actually is finished.

Recent research from journal editors shows that the RAE does not bring about improvement of research quality, although more manuscripts are submitted (Talib,

2000). It also finds that academics try to "'milk' as many paper as possible from projects" and publish "overlapping (similar)" articles. (ibid.: 42, 43) It is concluded by an editor's comments on the consequence of the RAE:

> Lots of 'salami slicing' going on
> RAE promotes salami slicing, pursuit of 'topical' research subjects, a preference of journal papers over books and a general short-termism
> RAE discourages genuinely innovative and risk-taking research
> RAE promotes a 'Marks and Spencer' rather than 'Vivienne Westwood' approach to research and writing
>
> (Talib, ibid.: 45)

In a similar vein, Harley (2002) discovers that the majority of staff in social science disciplines (sociology, psychology) and business-related disciplines (marketing, finance and accounting) share the same view that:

> there had been changes in recruitment and selection in their discipline generally, and in the work of their department in particular, in recent years, and that each was concentrating on the sort of criteria assumed to get a high rating in the periodic assessment experiences.
>
> (Harley, ibid.: 190)

She also finds that the reason why the majority of academics hold hostile attitudes towards the RAE is either because they feel themselves unfairly judged due to the devaluation of other academic activities caused by the RAE, or because they feel their academic life is distorted by it. (ibid.: 203)

All these criticisms are legitimate at least to some extent. A great part of them indeed are related to the research selectivity of the RAE, namely the distribution of research funding, and the pressure of doing research brought by the RAE. However, these issues are not the first concern of this study. This study at this point is only concerned about a good measurement of research. From this standpoint, it seems that the RAE is doing well. It proves itself in this aspect in two ways. Firstly, it is acknowledged to be an extremely thorough exercise. (Elkin & Law, ibid.: 137) The word 'thorough' has two meanings. On the one hand, it covers almost all academic departments in the UK. On the other, it covers the broad spectrum of research publications, apart from teaching materials. (HEFCE, 1996: 6) It is the only assessment of academic research that has been carried out on such a comprehensive scale in the UK.

Secondly and most importantly, its standardised scores make the comparison across universities and disciplines possible. The Research Assessment Exercise uses scores from 1 to 5* to assess departments across disciplines. For statistical analysis, these were transformed to scores 1-7. The meaning of each score, according to the Higher Education Funding Council (HEFCE, 1996), is presented in Table 5-2. For example, if a Chemistry department or an Education department is rated as 3a, it means that those two departments are more or less in the same group of research performance: "Research quality that equates to attainable levels of national excellence in a substantial majority of the sub-areas of activity". (see Table 5-2)

Table 5-2: Meanings of the RAE Scores

5*	Research quality that equates to attainable levels of international excellence in a majority of sub-areas of activity and attainable levels of national excellence in all others.
5	Research quality that equates to attainable levels of international excellence in some sub-areas of activity and to attainable levels of national excellence in virtually all others.
4	Research quality that equates to attainable levels of national excellence in virtually all sub-areas of activity, possibly showing some evidence of international excellence, or to international level in some and at least national level in a majority.
3a	Research quality that equates to attainable levels of national excellence in a substantial majority of the sub-areas of activity, or to international level in some and to national level in others together comprising a majority.
3b	Research quality that equates to attainable levels of national excellence in the majority of sub-areas of activity.
2	Research quality that equates to attainable levels of national excellence in up to half the sub-areas of activity.
1	Research quality that equates to attainable levels of national excellence in none, or virtually none, of the sub-areas of activity.

(HEFCE, 1996: 13)

In making these remarks I am not suggesting that the RAE is above suspicion. My point is simply that for the purpose of the present research, the RAE is a valid instrument. For this reason, the 1996 RAE, which was the most recent record when the research is carried out, was used in the statistical analysis. In addition, the 2001 RAE (HEFCE, 2001a, b) which was only just published when the analysis of data was already completed is briefly analysed in section 6.3.3 as an additional piece of evidence.

5.2.2 Measure of Teaching

'Teaching' is the idea that is used in the questionnaire and needs to be clarified in this section albeit in a restricted form: I will be concerned only with teaching in doctoral education and with the way teaching is related to both individual and aggregate levels of doctoral students' learning. A large part of the discussion has been taken up in Chapter Four. It is, however, useful to explore some related themes in this section. Of particular interest is student evaluation.

5.2.2.1 Background of the Questionnaire – Student Evaluation

Theall and Franklin (1997) contend "that the people best able to report what happens in a classroom are the people who are present for the full duration of the course and who are witness to and/or participate in the teaching process". (in Fourie, 2001: 84) In other words, students are legitimate raters. Hobson and Talbot (2001) highlight the important role of student evaluation especially in the "scholarship of teaching" (see section 2.2.3). It is found that student ratings are "more statistically reliable than colleague ratings, and are not easily or automatically manipulated by grades." (Cohen, 1981 in Fourie, 2001: 84) In a similar vein, Marsh finds that class-average student ratings are reliable, multidimensional and "relatively valid against a variety of indicators of effective teaching." (1987: 255) Furthermore, Nasser and Fresko discover that 447 lecturers involved in their study reveal "moderately positive attitudes towards the validity of student ratings and their usefulness for improving instruction." (2002: 196)

In this research, the main concern is to shed some light on the relationship between research and teaching from a doctoral student's standpoint. There has not been much literature, as pointed out in Chapter One, Two and Four, on the relationship between research and teaching in doctoral education, let alone the doctoral students' perspective on this subject matter. It is believed that students at the doctoral level are a legitimate source of evaluating the quality of doctoral education. In making these comments, I am not suggesting that student evaluation is free from dispute. Measuring the concept of teaching or doctoral education as a whole is not always

easy, and mistakes are inevitable. My aim here has been the very limited one of making it clear that it seems student evaluation to be the most appropriate measure of doctoral education for the purpose of this research.

There are some difficulties in using student questionnaires. For example, Heywood (2000: 102-103) claims that the outcome of student evaluation is "biased" by background characteristics such as the age, gender and discipline subjects. Shevlin et al. (2000) found that 69% and 37% of the variation in the 'lecturer ability' and 'module attributes' factors can be explained by the charisma factor. Hence, they argue that "a central trait exists which influences a student's evaluation of the lecturer." (ibid.: 397) It is also claimed that students do not have the necessary background to evaluate the course or teaching effectiveness. (Fourie, 2001: 84)

In response to these issues, Marsh highlights that "the mere existence of a significant correlation between students' evaluations and some background characteristic should not be interpreted as support for a bias hypothesis." (1987: 310) He points out seven drawbacks of those studies which claim biases in students' evaluations. The most serious mistake is that they use correlation to argue for a causal relationship. "The implication that some variable *biases* student ratings argues that causation has been demonstrated, whereas correlation only implies that a concomitant relation exists." (original italics, ibid.: 309) In other words, "the finding that a set of background characteristics are correlated with students' evaluations of teaching effectiveness should not be interpreted to mean that the ratings are biased." (ibid.)

5.2.2.2 Design of the Questionnaire

Following the discussion of related issues in doctoral education especially in section 4.2 and 4.3, this study generated six main questions to measure the effectiveness of supervision at the individual level in doctoral education. They are as follows:

- How active or productive is your supervisor as a researcher?
- How well are you made aware of your supervisor's research project(s)?
- Is your supervisor's own research project close to your thesis topic?
- How helpful is your supervisor in finding funding for your study?
- How helpful is your supervisor to your research?

- Do you consider that any aspect of your supervision is hindering your progress?
    a. Supervisor availability.
    b. Lack of helpful guidance/feedback from the supervisor.
    c. Supervisor's lack of knowledge (including giving incorrect and distracting information) in your field.
    d. Lack of support / encouragement from the supervisor.
    e. Supervisor's own research workload is too heavy.
    f. Supervisor has too many students.
    g. Supervisor is not interested or motivated.

Among them, the fifth question is treated as the general evaluation of the effectiveness of supervision. Students were asked to choose a number in a scale from 1-7: 1 as least favourable, 7 as most favourable. (see the questionnaire in Appendix 1)

At the aggregate level, results of many studies have recognized the importance of institutional factors with student achievement as discussed in section 4.2 and 4.3. By taking account of the points made in those above sections, seven major questions are generated to explore the quality of the research environment for doctoral students in helping them finish in time and in preparing them as good researchers.

- How satisfactory are the facilities and support services provided by your department/university?
    a. Library services.
    b. Individual working space.
    c. Computing facilities.
    d. Financial aid for your research work.
    e. Availability of formal communication channels, i.e. research student society, complaints and appeal procedures.
- How satisfactory is your research training programme?
- How are the following aspects of the academic atmosphere in your department?
    a. Friendliness of the academic staff. (Coded as Staff approachability)
    b. The interaction between staff and research students.
    c. The interaction among research students.
    d. Social events for research students.
    e. Research culture.
- Academic staff are too busy in their own researches to be available for students.
- How well are you made aware of the research projects among the staff in your department?
- How easily can you share the research facilities/resources with academic staff in your department?
- Do you consider any aspect of Inter-Cultural communication is hindering your learning? (for overseas students only)

a. Lack of information and help for overseas students. (e.g. visa application, legal advice.)
b. Lack of interaction among home and international students.
c. Lack of English language assistance.
d. Feelings of differential treatment or discrimination against overseas students.
e. Lack of sympathetic listening and personal support from the department.

All the questions ask students to choose from 1-7 with 1 as least favourable and 7 as most favourable. Apart from those questions, background information such as gender, domicile, subject and department was also collected. (A full copy of the questionnaire is contained in Appendix 1)

The survey was complemented by eight follow-up interviews which further explored the disciplinary difference in connection with the relationship between research and teaching.

5.2.2.3 Sampling

The overall sampling process can be broadly divided into three stages. The first stage was to identify the departments of Chemistry and Education which both appear on the list of the Research Assessment Exercise in 1996 (1996 RAE) and also have full-time PhD students. The 1996 RAE incorporated 62 Chemistry and 104 Education departments. All but one of the 62 Chemistry departments on the 1996 RAE list had full-time PhD students, apart from one institution whose Chemistry department was dissolved just as this study got under way. However, not all Education departments on the 1996 RAE list offered doctoral education. According to the Higher Education Statistics Agency 1997/98 (HESA, 1999), 68 institutions in Education had full-time postgraduate students. Among them, 63 Education departments were identified on the 1996 RAE list. Therefore, 61 Chemistry and 63 Education institutions were available for selection.

The second stage was selection. Because one department had already been chosen in each subject for the pre-test of the questionnaire, actually 60 Chemistry and 62 Education departments were available for sampling. The target has 50% of the

institutions in each subject. Randomness was achieved by writing each department's name on a small piece of paper and drawing them from a separate box for each subject. In case some of the institutions might refuse the request for survey, 35 departments from each subject were chosen at random.

The last stage was to make contact with the institutions selected. Either the research tutor or the head of these 70 departments was contacted for the survey. As expected, not all of them agreed to it. In Education, seven institutions turned down the request, whiie in Chemistry four institutions declined to help. In the end, twenty-eight Education and thirty-one Chemistry departments across the UK were surveyed. Once the research tutor or the head of the department agreed to help, questionnaires were sent to them. They were asked to pass the questionnaire on to their full-time PhD students. In each package for students, the questionnaire (Appendix 1), an introductory letter to students (Appendix 2), a note describing the guidelines (Appendix 3) and a stamped addressed envelope were included. In the letter to students, the confidentiality of the questionnaire was guaranteed.

About 2,200 questionnaires were distributed and 1,107 were returned. The response rate for Education was 81.3% and for Chemistry 41.3%; an overall average of 50.6%. It is interesting to note the high response rate from Education students and the relatively low response rate from Chemistry students. The possible reasons for this will be discussed in section 8.1.3. The method of distribution of the questionnaires and the overriding need for confidentiality made it impossible to issue reminders to individual non-respondents.

5.3 Interview Data

After completing the analysis of the questionnaires, some issues emerged which required follow-up. It was believed that the follow-up interviews would help to elucidate the quantitative results and open the door to future research.

Eight interviewees, four in Chemistry and four in Education, were chosen from students who left their correspondence details in the questionnaire. Among these four

students in each subject, two of them were chosen from institutions with high RAE scores such as 5 or 5*. Another two of them were from institutions with low RAE scores such as 1, 2, or 3b. Owing to financial constraints, seven of those interviewees were based in London and one out of London where a telephone interview took place. The interview questions are attached in Appendix 4. Eight interview reports were produced.

The following two chapters will firstly present the statistical analysis of the survey and secondly the analysis of the interviews.

Chapter Six

Statistical Analysis of the Relationship Between Staff Research and Effectiveness of Doctoral Education

This chapter examines the relationship between staff research and teaching in doctoral education and possible disciplinary differences. It begins by presenting the features of Education and Chemistry students. It then goes on to explore the relationship between the RAE ranking and student perceptions of effectiveness of doctoral education in Education and Chemistry by using regression analysis. Finally an overall evaluation of the results is given. All the statistics were computed using SPSS.

6.1 Analysis of the Data

This section provides an overview of the data. Firstly, the basic attributes of Education and Chemistry students are highlighted. Next, a basic crosstabulation is offered to show the differences between them. It is then followed by the principal component analysis to group responses to individual questions into major categories.

6.1.1 Characteristics of Education and Chemistry Students

Percentages for the major independent variables in Education and Chemistry are presented in Table 6-1. To begin with, in the sample of Education, the ratio of male to female full-time doctoral students is very close to 4:6, which corresponds with the data in HESA 1998/99 (2000: 40-41). In Chemistry, the ratio of male to female full-time doctoral students is close to 6: 4. Unfortunately there are no direct corresponding data for Chemistry as an individual subject that can be found in HESA 1998/99. (2000) The closest related field is Physical sciences in HESA 1998/99 (ibid.) which shows that a ratio of male to female full-time PhD students is 6: 2 (7920: 2516).

In terms of domicile, almost two-thirds of the Education sample are from foreign countries: about one-fifth of the whole sample is from European countries, more than one quarter from Asian countries and more than one-sixth from other countries. In contrast, slightly more than two-thirds of Chemistry PhD students are home students. Students from Asian countries comprise less than one-tenth of the Chemistry sample. European PhD students in Chemistry are in the ratio as 1 to 5.

English is the second or foreign language for almost two-thirds of Education students. In contrast, about three quarters of Chemistry students are native English speakers. Unfortunately there is no corresponding data that can be found in HESA 1998/99.

Table 6-1: Basic Statistics in Education and Chemistry

		Education (%)	Chemistry (%)
Gender	Male	38.7	59.8
	Female	61.3	40.2
Domicile	UK	35.3	68.4
	European Union	21.8	20.7
	Far East Asian countries	21.5	11.1
	Other Asian countries	4.5	2.9
	Other countries	16.9	8.4
English Familiarity	English as mother tongue	37.9	72.0
	English as second language	16.4	7.0
	English as foreign language	45.8	21.0
Year of Study	First year	24.0	32.9
	Second year	23.2	25.2
	Third year	27.7	29.4
	Fourth year or more	25.1	12.5
Funding	Self-funding	32.5	4.5
	Sponsored	67.5	95.5

Furthermore, Education students in the sample are more or less evenly distributed from the 1st to the 4th or more years of study – about one quarter in each category. About one-third of them are self-funded. On the contrary, "Year of study" in Chemistry shows a dramatic drop at the 4th year of PhD study. This suggests that the majority of the doctoral students in Chemistry tend to finish their study in less than four years. Regarding funding issues, only a very small number of chemistry students are self-funded. More than nine-tenth of students are sponsored.

Table 6-2: Distribution of Students in Education and Chemistry by the RAE Scores

	The RAE Scores		
	Low (%)	**Medium** (%)	**High** (%)
Education			
Sample in the study	14.1	27.4	58.5
Education (HESA 1998/99)	12.6	45.2	42.2
Chemistry			
Sample in the study	20.0	33.5	46.5
Physical sciences (HESA 1998/99)	13.1	42.3	44.6

When the RAE scores are categorised into three groups – 1, 2, 3b as low RAE scores; 3a, 4 as medium; 5, 5* as high, Table 6-2 shows that in this research, over half of PhD students in Education are from departments with high RAE scores; about a quarter of them from departments with medium RAE scores and only about one-seventh from departments with low RAE scores. According to the data in HESA 1998/99 (2000: 152-159), the numbers of full-time postgraduate students (research) in Education departments with high and medium scores are similar: about two-fifths in each category: 42.2% and 45.2%. The slight difference between the sample of the research and the data in HESA 1998/99 concerning the proportion of students in the departments with medium scores may be due to the facts that the "postgraduate students (research)" defined by HESA 1998/99 can include master students following a research route. It is perhaps probable that the data of HESA did not include PhD students who registered the course after the departments submitted the information to HESA. It could also be due to the fact that the HESA data did not take into account that some PhD students had transferred their registration from full-time students to part-time students during their study or vice versa.

In Chemistry, less than half of PhD students are from departments with high RAE scores in the research; one-third of them from departments with medium RAE scores and one-fifth of them from departments with low RAE scores. This roughly corresponds with the data found in Physical sciences in HESA 1998/99 (ibid.).

6.1.2 Basic Crosstabulation

A basic crosstabulation is presented in Table 6-3 to show the variation in students' experiences between Education and Chemistry. Items have been coded such that a high score represents a positive response. Independent sample t-test is employed for comparing the means. Statistically significant differences between Education and Chemistry students are indicated by asterisks. The full t-test output of this calculation is attached in Appendix 5.

The values of the means and the significance signs in Table 6-3 indicate that generally speaking Chemistry departments are appreciated more than Education departments on almost all counts. At the individual level, supervision is perceived to be more satisfactory in Chemistry than in Education especially in aspects of supervisor's knowledge, supervisor's research workload, supervisor's student-load and supervisor's helpfulness in finding funding. Next, Chemistry students are more aware of their supervisors' projects than Education students. Chemistry supervisors' projects are seen to be closer to students than Education supervisors'. The only exceptions are student's perceptions of supervisor's productivity and supervisor availability. Supervisors in Education are perceived to be more productive and available than their counterparts in Chemistry.

The general favourable opinions towards Chemistry supervision could explain why Chemistry students have much less experience of changing supervisor. The questionnaire found that only seven percent of Chemistry students changed their supervisor, while more than twenty percent of Education students had done so.

At the aggregate level, Chemistry departments are seen to have a more favourable research environment for doctoral students than Education departments. Chemistry departments are perceived to be significantly better in staff approachability, social events for research students, research culture, staff availability. Moreover, Chemistry students are made more aware of staff research, have better research culture, have better interaction with people in the department, and have more shared facilities

Table 6-3: Main Results of T test of Students' Learning Experiences in Education and Chemistry

Effectiveness of Doctoral Education	**Education** Mean (Std. Deviation)	**Chemistry** Mean (Std. Deviation)
Individual Level – Supervisory Effectiveness		
Overall helpfulness of supervision	5.38 (1.65)	5.43 (1.63)
Student's perception of supervisor's productivity	***5.32*** (2.10)	4.73 (2.22)
Awareness of supervisor's projects	4.43 (1.94)	***5.31*** (1.71)
Similarity between supervisor and students' projects	3.83 (2.15)	***4.86*** (2.24)
Supervisor's helpfulness in finding funding	4.03 (2.40)	***5.91*** (1.48)
Supervisor availability	***5.61*** (1.76)	5.29 (1.81)
Supervisor's guidance/ feedback	5.38 (1.79)	5.26 (1.78)
Supervisor's knowledge	5.68 (1.71)	***5.91**** (1.62)
Supervisor's support/ encouragement	5.73 (1.72)	5.62 (1.67)
Supervisor's research workload	5.02 (1.94)	***5.29**** (1.76)
Supervisor's student-load	5.39 (1.94)	***5.63**** (1.71)
Supervisor's interest/ motivation	6.01 (1.67)	6.18 (1.48)
Aggregate Level – Effectiveness of Research Environment for Doctoral Students		
Research training programme	***3.73**** (1.57)	3.47 (1.46)
Staff approachability (Friendliness of the academic staff)	5.17 (1.63)	***5.47*** (1.24)
Interaction between staff & students	4.54 (1.73)	***5.17*** (1.33)
Interaction among students	4.28 (1.63)	***5.41*** (1.35)
Social events for research students	3.44 (1.61)	***4.46*** (1.71)
Research culture	4.20 (1.74)	***4.76*** (1.44)
Staff availability	4.33 (1.90)	***4.80*** (1.63)
Awareness of staff research	3.60 (1.78)	***4.11*** (1.58)
Facilities shared between staff & students	3.68 (1.83)	***4.89*** (1.47)
Information for overseas students	5.00 (1.99)	***5.60*** (1.66)
Interaction with home students	4.66 (1.99)	***5.39*** (1.67)
English assistance[a]	4.67 (2.07)	***5.44*** (1.76)
Equal treatment (not discriminated against)	4.93 (2.03)	***5.72*** (1.66)
Sympathetic listening	5.05 (1.96)	***5.57*** (1.68)
(The above five items are only for foreign students)		
Library	5.14 (1.46)	5.09 (1.37)
Individual working space	3.83 (2.00)	***4.92*** (1.57)
Computing facilities	4.14 (1.81)	***4.80*** (1.58)
Financial support for students' work	3.53 (2.16)	***5.13*** (1.49)
Communication channel	4.08 (1.70)	4.21 (1.48)

Note: Items are coded in a scale from 1-7: 1 as least favourable, 7 as most favourable. (see the questionnaire in Appendix 1)

*. It is significant at the 0.05 level (2-tailed).

**. It is significant at the 0.01 level (2-tailed).

[a]: English assistance here excludes those foreign students with English as their mother tongue.

with staff, leading to better resources, than Education students. Individual working space, Financial support for students' work and Computing facilities for students are more appreciated in Chemistry than in Education. The finding of favourable responses towards Chemistry departments is also found among foreign students. Chemistry departments are seen to be better in providing information for overseas students, English assistance, equal treatment and sympathetic listening. Foreign students in Chemistry are more satisfied with the interaction with home students than their counterparts in Education.

The only exception is research training programmes: Education departments' research training courses are slightly more favourably perceived than those of Chemistry departments.

The analysis has so far considered the disciplinary variations in students' learning experiences. The data will be further explored when the RAE scores and other variables are taken into account in section 6.3.

6.1.3 Principal Component Analysis

Factor analysis is adopted to "simplify complex sets of data" (Kline, 1994: 3). It aims to "investigate the relationships between manifest variables and factors without making any prior assumptions about which manifest variables are related to which factors." (Everitt & Dunn, 2001: 271) A major assumption underlying factor analysis is that "it is not possible to observe these factors directly; the variables depend upon the factors but are also subject to random errors". (Mardia, Kent & Bibby, 1979: 255)

Principal component analysis was chosen from different methods of factor analysis for several reasons. First, different from other methods such as principal factors analysis (one method of factor analysis), Principal component analysis takes account of "all the variance in any particular correlation matrix, including the error variance." (Kline, op cit.: 40) Second, only the largest components are extracted. (ibid.) Third, the most variance is explained by the first principal component. (ibid.)

The Varimax method was used to rotate the components. The reason for choosing the Varimax method of rotation is that it is "the most efficient procedure" in making the factor axes orthogonal, meaning that the rotated components are held uncorrelated while "the communalities and the ability to reproduce the original correlation matrix are identical to the original factor analysis." (ibid.: 67-68) The results of Principal component analysis of effectiveness of doctoral education at both individual and aggregate levels – supervision and research environment for doctoral students, are presented in the following two sections.

6.1.3.1 Individual Level - Supervisory Effectiveness

In identifying the underlying components of Supervisory effectiveness, twelve items of the main supervisor were examined by Principal component analysis. The factor loadings of each item are presented in Table 6-4. The full SPSS output of this Principal component analysis is shown in Appendix 6.

The Principal component analysis in Table 6-4 identified three major components of the effectiveness of Supervision, which I will call, Supervisor's facilitation of learning, Supervisor's accessibility and Relevance of supervisor's research to student's. The first component, Supervisor's facilitation of learning, is mainly associated with the following six items: supervisor's knowledge, supervisor's interest/ motivation, supervisor's support/ encouragement, supervisor's guidance/ feedback, overall helpfulness of supervision, supervisor's helpfulness in finding funding. The second component, Supervisor's accessibility, mainly involves three items: supervisor's research workload, supervisor's availability and supervisor's student-load. Finally, the third component, Relevance of supervisor's research to student's, is primarily concerned with the remaining items: awareness of supervisor's projects, student's perception of supervisor's productivity and closeness of research projects.

Table 6-4: Factor Loadings of the Three Components in Supervision

Rotated Component Matrix [a]

	Component		
	1	2	3
Overall helpfulness	**.613**	.402	.390
Awareness of supervisor's projects	.212	.132	**.793**
Similarity between supervisor and students' projects	.261	3.206E-02	**.751**
Supervisor's helpfulness in finding funding	**.531**	-4.28E-02	.298
Supervisor availability	.233	**.760**	.187
Supervisor's guidance/ feedback	**.690**	.497	.199
Student's perception of supervisor's productivity	6.578E-02	.141	**.761**
Supervisor's knowledge	**.805**	.109	.152
Supervisor's support/ encouragement	**.715**	.404	.122
Supervisor's research workload	.138	**.810**	5.623E-02
Supervisor's student-load	.188	**.751**	5.535E-02
Supervisor's interest/ motivation	**.758**	.286	8.302E-02

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Figures in bold are those that contribute most to each principal component.

6.1.3.2 Aggregate Level - Effective Research Environment for Doctoral Students

In condensing the matrix of correlations measuring the effective Research environment for doctoral students, Principal component analysis was used firstly to extract major components from thirteen items to which all samples were involved; secondly to extract components from another five items in which only overseas students responded. The single item of Research training programmes is directly calculated in the regression analysis in the next section.

Table 6-5: Factor Loadings of the Two Components in Research Environment for Doctoral Students

Rotated Component Matrix [a]

	Component	
	1	2
Research culture	**.721**	.282
Staff availability	**.508**	.132
Awareness of staff research	**.547**	.159
Facilities shared between staff & students	**.570**	.419
Staff approachability	**.751**	.118
Interaction between staff & students	**.815**	.197
Interaction among students	**.704**	.125
Social events for research students	**.694**	.157
Library	5.858E-02	**.546**
Individual working space	.165	**.752**
Computing facilities	.166	**.744**
Financial support for student's research	.230	**.591**
Communication channel	.451	**.509**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Figures in bold are those that contribute most to each principal component.

The Principal component analysis of thirteen items of Research environment for doctoral students identified two major components, which I will call, Academic culture of social interaction and Research facilities (for students). As shown in Table 6-5, the first component, Academic culture of social interaction, is mostly related to the eight aspects of the Research environment for doctoral students: interaction between staff and students, staff approachability, research culture, interaction among students, social events for research students, facilities shared between staff and students, awareness of staff research, and staff availability.

The second component, Research facilities, mainly involves five aspects: individual working space, computing facilities, financial support for student's research, library and communication channel. Full details are given in Appendix 7.

The second Principal component analysis of the five items of Research environment for doctoral students completed only by foreign students produced one principal component. The factor loadings in each item are presented in the following Table 6-6. The full SPSS output of this factor analysis is shown in Appendix 8.

Table 6-6: Factor Loadings of One Component in Research Environment for Foreign Doctoral Students

Component Matrix [a]

	Component
	1
Information for overseas students	**.758**
Interaction with home students	**.758**
English assistance	**.745**
Equal treatment	**.831**
Sympathetic listening	**.831**

Extraction Method: Principal Component Analysis.

a. 1 component extracted.

This principal component of the five items in Research environment for doctoral students in Table 6-6, which I will call, Intercultural facilitation for research, is mainly related to the question: whether foreign doctoral students' research progress is hindered by the following intercultural aspects – information for overseas students, interaction with home students, English assistance, equal treatment and sympathetic listening.

Having identified the three major components together with the variable of Research training programmes, I now examine their relationship with the RAE by using regression analysis.

6.2 Correlation between Staff Research and Student Perception of the Effectiveness of Doctoral Education

6.2.1 Correlation at Individual Level – Simple Regression Analysis of Supervisory Effectiveness

Key results extracted from the simple linear regression of the RAE scores (7-point scale) and three principal components of supervisory effectiveness in two subjects are presented in Table 6-7. The results are separately calculated in Education and Chemistry by the following three equations:

Supervisor's facilitation of learning = f (RAE)
Supervisor's accessibility = f (RAE)
Relevance of supervisor's research to student's = f (RAE)

The full SPSS output of this simple linear regression of two subjects is provided in Appendix 9.

Table 6-7: The RAE and Supervisory Effectiveness in Education and Chemistry

Supervisory Effectiveness	Education			Chemistry		
	Beta of RAE	T	Sig.	Beta of RAE	T	Sig.
Supervisor's facilitation of learning	-.08	-1.31	.19	-.00	-.03	.98
Model Summary: R Square (Adjusted R Square)	.01 (.00)			.00 (-.00)		
Supervisor's accessibility	-.02	-.31	.75	-.08	-1.90	.06
Model Summary: R Square (Adjusted R Square)	.00 (-.00)			.01 (.01)		
Relevance of supervisor's research to student's	.04	.66	.51	.07	1.63	.10
Model Summary: R Square (Adjusted R Square)	.00 (-.00)			.01 (.00)		

The results of simple regression (Table 6-7) show that the RAE scores have little direct bearing on any of the three aspects of supervisory effectiveness (supervisor's facilitation of learning, supervisor's accessibility and relevance of supervisor's research to student's) in either Education or Chemistry since adjusted R squares are all small. If anything, the Beta coefficients suggest a very slight negative relationship between the RAE and supervisor's facilitation of learning in Education; a very slight

negative relationship between the RAE and supervisor's accessibility in Chemistry and a very slight positive relationship between the RAE and relevance of supervisor's research to student's in Chemistry, but none of them are significant.

In general, departments with higher RAE scores regardless of the subjects are not perceived by students to be better in supervisor's facilitation of learning or supervisor's accessibility. Supervisor's research is not closer to that of students in departments with higher RAE scores. According to these indicators, there is little connection between supervisory effectiveness and staff research measured by the RAE scores.

6.2.2 Correlation at Aggregate Level - Simple Regression Analysis of Effective Research Environment for Doctoral Students

Major results extracted from simple linear regression of the RAE scores and important components of effective research environment for doctoral students (including the single item regarding the research training programmes) in two subjects are presented in Table 6-8. The results are separately calculated in Education and Chemistry by the following four equations:

Academic culture of social interaction = f (RAE)
Intercultural facilitation of research = f (RAE)
Research training programmes = f (RAE)
Research facilities = f (RAE)

The full SPSS output of this simple linear regression of the two subjects is shown in Appendix 10.

A similar result is found at the aggregate level. Table 6-8 shows that the RAE is not a useful predictor in explaining the variance in any of the four aspects of effective research environment for doctoral students (academic culture of social interaction, intercultural facilitation of research, research training programmes and research facilities) in either Education or Chemistry, since the adjusted R squares are all small. Having recognised this, it is interesting to note the contrast contributions made by the RAE to student research facilities as shown by the Beta coefficients: in Education, the

RAE's contribution is significantly negative, whereas in Chemistry, the RAE's contribution is significantly positive. In other words, research facilities in departments with higher RAE scores are more satisfactory in Chemistry but less satisfactory in Education.

Table 6-8: The RAE and Effective Research Environment for Doctoral Students in Education and Chemistry

Effective Research Environment for Doctoral Students	Education			Chemistry		
	Beta of RAE	T	Sig.	Beta of RAE	T	Sig.
Academic culture of social interaction	-.02	-.34	.73	-.14	-3.40	.00
Model Summary: R Square (Adjusted R Square)	.00 (-.00)			.02 (.02)		
Intercultural facilitation of research	-.08	-1.14	.25	.04	.54	.59
Model Summary: R Square (Adjusted R Square)	.01 (.00)			.00 (-.00)		
Research training programmes	.01	.11	.91	.19	3.22	.00
Model Summary: R Square (Adjusted R Square)	.00 (-.00)			.03 (.03)		
Research facilities	-.19	-3.38	.00	.25	6.21	.00
Model Summary: R Square (Adjusted R Square)	.04 (.03)			.06 (.06)		

The Beta values also show that research training programmes are more appreciated in Chemistry departments with higher RAE scores, whereas academic culture of social interaction is less appreciated. There may be a very slight negative relationship between the RAE and intercultural facilitation of research for foreign doctoral students in Education, but it is not significant.

6.3 Exploration of Disciplinary Differences and Other Independent Variables

In order to further probe possible relationships between the RAE and effectiveness of doctoral education, two subjects together with other independent variables were treated as dummy variables in multiple regression analysis.

Throughout the analysis, the 1996 RAE was the most recent research record when the research carried out as addressed in section 5.2.1. The analysis of the 1996 RAE, the major analysis, is provided in the following two sections (6.3.1 & 6.3.2). Nevertheless, the 2001 RAE, which was just published after the completion of this data analysis, was briefly analysed and attached as an additional piece of evidence in section 6.3.3.

6.3.1 Multiple Regression Analysis of Supervisory Effectiveness

The results of multiple linear regression of three aspects of supervision -- supervisor's facilitation of learning, supervisor accessibility and relevance of supervisor's research to student's -- are presented in Table 6-9, 6-10 and 6-11.

In order to select the significant variables and reduce the problem of multicollinearity in multiple regression, two steps were adopted in this and the following sections. In the first stage, Stepwise regression which "performs a more thorough search than either forward selection or backward elimination" (Schulman, 2000: 421) is used to choose variables from Gender, Year of study, UK students, European students, Asian student and Far East Asian students, English as mother tongue and English as foreign language. In the second stage, according to the result of Stepwise multiple regression, variables with significant t values are selected to be in the final equation of multiple regression. In addition, variables with academic interest, such as the RAE, Subject, Gender and Year of study are also chosen for the final model, even though they may have non-significant t values in the result of Stepwise regression.

The final statistical results are calculated by the following three equations:

Supervisor's facilitation of learning = f (RAE, Subject, Year of study, Asian students, Gender)

Supervisor's accessibility = f (RAE, Subject, Year of study, English as foreign language, Gender)

Relevance of supervisor's research to student's = f (RAE, Subject, Gender, English as mother tongue, Asian students, Year of study)

Among the independent variables, apart from the RAE and Year of study, all the others are treated as dummy variables. Year of study is coded from 1 to 4: 1 as the first year of PhD study; 4 as the 4th or more year. The full SPSS output of the multiple regression analysis of the three aspects of supervision in both subjects is shown in Appendix 12.

In the light of the findings in section 6.2.1, the above results were also examined by calculating the separate equations for Education and Chemistry. However, the outcomes of this further examination are only reported in the text when there are discrepant findings, meaning the change of the directions of the signs or the change of the significance level, from the above calculations.

To begin with, in supervisor's facilitation of learning (Table 6-9), the non-significant t value shows that having controlled for other variables, the RAE does not have any bearing on supervisor's facilitation of learning. It is important to note that subject differences significantly contribute to the variances of supervisor's facilitation of learning. Chemistry students, junior students and non-Asian (UK, European and others) students are likely to be more satisfied with supervisor's facilitation of learning than Education students, senior students and Asian students.

Table 6-9: Multiple Regression for Predicting Supervisor's Facilitation of Learning

Supervisor's Facilitation of Learning	**Beta**	**T**	**Sig.**
RAE	-.01	-.20	.84
Subject *(Edu: 1; Che: 0)*	-.10	-2.89	.00
Year of study	-.17	-5.02	.00
Asian students *(Asian: 1; Others: 0)*	-.17	-4.83	.00
Gender *(Female: 1; Male: 0)*	.03	.88	.38
Model Summary: R Square (Adjusted R Square)		.09 (.08)	

A similar result is found in supervisor's accessibility (Table 6-10). The non-significant t value shows that the RAE cannot explain the variances of supervisor's accessibility. The disciplinary effect is also revealed. The Beta coefficients demonstrate that Subject has the greatest explanatory effect on supervisor's accessibility and English as foreign language the next highest. In other words, having

controlled for other variables, Education students, students with English as mother tongue or the second language, and junior students are likely to be more satisfied with supervisor's accessibility than Chemistry students, students with English as foreign language and senior students.

Table 6-10: Multiple Regression for Predicting Supervisor's Accessibility

Supervisor's Accessibility	**Beta**	**T**	**Sig.**
RAE	-.05	-1.52	.13
Subject *(Edu: 1; Che: 0)*	.16	4.46	.00
Year of study	-.11	-3.32	.00
English as foreign language*	-.13	-3.57	.00
Gender *(Female: 1; Male: 0)*	.04	1.02	.31
Model Summary: R Square (Adjusted R Square)		.04 (.04)	

(* English as foreign language: 1; English as mother tongue or the second language: 0)

In a similar vein, the non-significant t values (Table 6-11) show that the RAE together with English as mother tongue, Asian students and Year of study are not related to the prediction of Relevance of supervisor's research to student's. Again, the Beta

Table 6-11: Multiple Regression for Predicting Relevance of Supervisor's Research to Student's

Relevance of Supervisor's Research to Student's	**Beta**	**T**	**Sig.**
RAE	.06	1.77	.08
Subject *(Edu: 1; Che: 0)*	-.08	-2.11	.04
Gender *(Female: 1; Male: 0)*	-.12	-3.40	.00
English as mother tongue*	-.00	-.17	.87
Asian students *(Asian: 1; Others: 0)*	-.02	-.57	.57
Year of study	-.00	-.20	.85
Model Summary: R Square (Adjusted R Square)		.03 (.02)	

(*English as mother tongue: 1; English as foreign or the second language: 0)

coefficients point out the significant difference between the two subjects in relevance of supervisor's research to student's. That is, having controlled for other variables, research of Chemistry students and male students is closer to their supervisor's research than research of Education students and female students to their supervisor's.

6.3.2 Multiple Regression Analysis of Effective Research Environment for Doctoral Students

The results of multiple linear regression of research environment for doctoral students – academic culture of social interaction, intercultural facilitation of research, research training programmes and research facilities are presented in Table 6-12, 6-14, 6-15 and 6-17.

Table 6-12 shows that having controlled for other variables, the RAE slightly negatively relates to the academic culture of social interaction. The table also shows that there is a significant disciplinary difference here. The Beta coefficients indicate that Subject makes the greatest difference to the perceptions of academic culture of research facilitation and Year of study the next highest. In particular, Chemistry students, junior students, non-Asian students, and students from low RAE departments are likely to be more satisfied with academic culture of social interaction than Education students, senior students, Asian students and students in high RAE departments.

Table 6-12: Multiple Regression for Predicting Academic Culture of Social Interaction

Academic Culture of Social Interaction	**Beta**	**T**	**Sig.**
RAE	-.07	-2.25	.03
Subject *(Edu: 1; Che: 0)*	-.15	-4.29	.00
Year of study	-.14	-4.52	.00
English as mother tongue*	.08	2.10	.04
Asian students *(Asian: 1; Others: 0)*	-.09	-2.42	.02
Gender *(Female:1;Male: 0)*	-.05	-1.64	.10
Model Summary: R Square (Adjusted R Square)		.11 (.11)	

(* English as mother tongue: 1; English as foreign or the second language: 0)

The above findings are further examined by calculations for Education and Chemistry separately. Table 6-13 is interesting both for what it contains and for what it does not. First and foremost, it reveals the distinct relationships between the RAE and academic culture of social interaction within subjects. That is, having controlled other

variables, the negative contribution of the RAE only exists in Chemistry, but not in Education. Secondly, the significantly negative perceptions of the academic culture of social interaction from Asian students only exists in Education, whereas the significantly positive perceptions from students with English as mother tongue is only present in Chemistry. Furthermore, as already noted, Year of study appears to be negatively related to academic culture of social interaction in both subjects. Senior doctoral students are less satisfied with academic culture of social interaction regardless of their subjects.

Table 6-13: Multiple Regression for Predicting Academic Culture of Social Interaction in Education and in Chemistry

Academic Culture of Social Interaction	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
RAE	.02	.38	.71	-.13	-3.17	.00
Year of study	-.14	-2.49	.01	-.15	-3.62	.00
*English as mother tongue**	.05	.87	.39	.11	2.39	.02
Asian students (Asian: 1; Others: 0)	-.13	-2.04	.04	-.06	-1.28	.20
Gender (Female:1;Male: 0)	-.09	-1.68	.09	-.03	-.80	.43
Model Summary: R Square (Adjusted R Square)	.05 (.04)			.06 (.05)		

(*English as mother tongue: 1; English as foreign or the second language: 0)

The results of intercultural facilitation of research for foreign students are shown in Table 6-14. There is little doubt that, having controlled for other variables, the RAE is not related to intercultural facilitation of research for foreign doctoral students as is shown by the non-significant t value. As might be expected, disciplinary difference has significant influence on the perceptions of intercultural facilitation of research. Chemistry foreign doctoral students are more satisfied with intercultural facilitation of research than Education foreign doctoral students. In addition, Asian students and foreign students with English as foreign or the second language are less satisfied with intercultural facilitation of research than non-Asian students and those foreign students whose English is mother tongue.

Table 6-14: Multiple Regression for Predicting Intercultural Facilitation of Research (for Foreign Doctoral Students)

Intercultural Facilitation of Research	**Beta**	**T**	**Sig.**
RAE	.00	.01	1.00
Subject *(Edu: 1; Che: 0)*	-.16	-3.32	.00
English as mother tongue*	.12	2.53	.01
Asian students *(Asian: 1; Others: 0)*	-.21	-4.40	.00
Year of study	-.07	-1.46	.15
Gender *(Female:1;Male: 0)*	-.03	-.55	.58
Model Summary: R Square (Adjusted R Square)	.13 (.11)		

(*English as mother tongue: 1; English as foreign or the second language: 0)

Table 6-15 summarises the information on research training programmes. It shows that, having controlled for other variables, the RAE has a slight but significant effect on research training programmes. It is noteworthy that Education students are more satisfied with research training programmes than Chemistry students. Furthermore, non-Far East Asian students and junior students are likely to be more satisfied with research training programmes than Far East Asian students and senior students.

Table 6-15: Multiple Regression for Predicting Students Views of Research Training Programmes

Research Training Programmes	**Beta**	**T**	**Sig.**
RAE	.10	2.41	.02
Subject *(Edu: 1; Che: 0)*	.11	2.53	.01
Year of study	-.11	-2.59	.01
Far East Asian students*	-.12	-2.80	.01
Gender *(Female:1;Male: 0)*	.08	-1.96	.05
Model Summary: R Square (Adjusted R Square)	.05 (.04)		

(* Far East Asian students: 1; Others: 0)

The results of further examination of research training programmes by separately calculating Education and Chemistry are shown in Table 6-16.

Table 6-16: Multiple Regression for Predicting Research Training Programmes in Education and in Chemistry

Research Training Programmes	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
RAE	.02	.38	.71	.18	3.12	.00
Year of study	-.13	-2.35	.02	-.08	-1.37	.17
Far East Asian students*	-.16	-2.91	.00	.00	.12	.91
Gender *(Female:1;Male: 0)*	-.06	-1.11	.27	-.08	-1.38	.17
Model Summary: R Square (Adjusted R Square)	.05 (.04)			.05 (.03)		

(* Far East Asian students: 1; Others: 0)

Table 6-16 reveals the disciplinary diversity in the relationship between the RAE and research training programmes. Having controlled for other variables, the positive relationship between the RAE and research training programmes only exists in Chemistry, but not in Education. Moreover, the significantly negative perceptions of research training programmes from Far East Asian students and senior students (Year of study) only exist in Education. They are non-significant in Chemistry.

The results of research facilities are set out in Table 6-17. The Beta coefficients show that Subject is more important than the RAE and Far East Asian students in explaining the variance in research facilities. Education students are significantly less satisfied with research facilities than Chemistry students. It shows that on the whole the RAE has a slight positive relationship with research facilities.

Table 6-17: Multiple Regression for Predicting Research Facilities

Research Facilities	Beta	T	Sig.
RAE	.10	2.91	.00
Subject *(Edu: 1; Che: 0)*	-.22	-6.40	.00
Far East Asian students*	-.11	-3.26	.00
Year of study	-.02	-.54	.59
Gender *(Female:1;Male: 0)*	-.03	-.86	.39
Model Summary: R Square (Adjusted R Square)	.08 (.07)		

(* Far East Asian students: 1; Others: 0)

Table 6-18 gives the information of the further analysis of research facilities for Education and Chemistry.

Table 6-18: Multiple Regression for Predicting Research Facilities in Education and in Chemistry

Research Facilities	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
RAE	-.15	-2.79	.01	.25	6.21	.00
Far East Asian students*	-.17	-3.04	.00	.01	.17	.87
Year of study	-.05	-.83	.41	-.02	-.51	.61
Gender *(Female:1;Male: 0)*	-.01	-.22	.82	-.01	-.34	.74
Model Summary: R Square (Adjusted R Square)	.07 (.05)			.06 (.06)		

(* Far East Asian students: 1; Others: 0)

What is especially striking in Table 6-18 is that the RAE and research facilities have contrasting relationships within the two subjects. Having controlled for other variables, the RAE actually has a significant negative relationship with research facilities in Education and a significant positive relationship in Chemistry. In addition, the significant negative perceptions of research facilities from Far East Asian students only exist in Education. It is non-significant in Chemistry.

6.3.3 Multiple Regression Analysis with the 2001 RAE

6.3.3.1 Multiple Regression Analysis of Supervisory Effectiveness

The results of multiple regression analysis of the three components in supervisory effectiveness with the 2001 RAE and other variables are presented in Table 6-19, 6-20 and 6-21. The full SPSS output is provided in Appendix 11.

Table 6-19 shows that when other variables are hold constant, the 2001 RAE is not related to supervisor's facilitation of learning. Significantly, supervisor's facilitation of learning is more favourably perceived in Chemistry than in Education. Also, Asian students and senior students are less satisfied with supervisor's facilitation of learning than non-Asian students and junior students.

Table 6-19: Multiple Regression for Predicting Supervisor's Facilitation of Learning with 2001 RAE

Supervisor's Facilitation of Learning	Beta	T	Sig.
2001 RAE	-.02	-.06	.55
Subject *(Edu: 1; Che: 0)*	-.11	-3.11	.00
Year of study	-.16	-4.76	.00
Asian students *(Asian: 1; Others: 0)*	-.17	-4.89	.00
Gender *(Female: 1; Male: 0)*	.03	.85	.34
Model Summary: R Square (Adjusted R Square)		.09 (.08)	

The multiple regression of supervisor's accessibility with the 2001 RAE reveals similar results to the major analysis in section 6.3.1. (Table 6-20) As already noted, the disciplinary factor contributes to the differences of perceptions on supervisor's accessibility. Supervisors are perceived to be more accessible in Education than in Chemistry. Students with English as foreign language and senior students are less satisfied with supervisor's accessibility than students with English as mother tongue or the second language and junior students.

Table 6-20: Multiple Regression for Predicting Supervisor's Accessibility with 2001 RAE

Supervisor's Accessibility	Beta	T	Sig.
2001 RAE	-.08	-2.33	.02
Subject *(Edu: 1; Che: 0)*	.13	3.56	.00
Year of study	-.11	-3.22	.00
English as foreign language*	-.13	-3.62	.00
Gender *(Female: 1; Male: 0)*	.04	1.23	.22
Model Summary: R Square (Adjusted R Square)		.05 (.04)	

(* English as foreign language: 1; English as mother tongue or the second language: 0)

However, the striking fact in Table 6-20 is that in contrast to the regression result by using the 1996 RAE, having taken account of other variables, the 2001 RAE negatively contributes to supervisor's accessibility.

Table 6-21 shows that the 2001 RAE has little bearing on relevance of supervisor's research to student's. It also reveals the disciplinary effect. Education supervisor's research is slightly less relevant to student's than Chemistry supervisor's research to

that of students. Also supervisor's research is perceived to be less relevant by female students than male students.

The above analysis with the 2001 RAE reinforces the main analysis in section 6.3.1, especially with regard to supervisor's accessibility.

Table 6-21: Multiple Regression for Predicting Relevance of Supervisor's Research to Student's with 2001 RAE

Relevance of Supervisor's Research to Student's	**Beta**	**T**	**Sig.**
2001 RAE	-.01	-.27	.79
Subject *(Edu: 1; Che: 0)*	-.09	-2.27	.02
Gender *(Female: 1; Male: 0)*	-.12	-3.30	.00
English as mother tongue*	-.02	-.52	.60
Asian students *(Asian: 1; Others: 0)*	-.03	-.63	.53
Year of study	-.00	-.00	.95
Model Summary: R Square (Adjusted R Square)		.03 (.02)	

(*English as mother tongue: 1; English as foreign or second language: 0)

6.3.3.2 Multiple Regression Analysis of Effective Research Environment for Doctoral Students

The results of multiple regression analysis of four components of effective research environment for doctoral students are presented in the following tables. To avoid repetition, the separate results of Education and Chemistry are presented only if there are discrepant findings between the two subjects. The full SPSS output is shown in Appendix 12.

Table 6-22 shows a contrast between Education and Chemistry related to academic culture of social interaction. The most remarkable result is that the effect of the 2001 RAE only exists in Chemistry, but not in Education. Academic culture of social interaction is perceived to be less satisfactory in Chemistry departments with higher RAE scores. Senior students, regardless of their subjects, are less satisfied with academic culture of social interaction than junior students. Asian students in

Education, but not in Chemistry are less satisfied with academic culture of social interaction than non-Asian students.

Table 6-22: Multiple Regression for Predicting Academic Culture of Social Interaction in Education and in Chemistry with 2001 RAE

Academic Culture of Social Interaction	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
2001 RAE	.01	.19	.85	-.16	-3.85	.00
Year of study	-.14	-2.50	.01	-.13	-3.21	.00
English as mother tongue*	.05	.82	.41	.08	1.84	.07
Asian students *(Asian: 1; Others: 0)*	-.12	-2.02	.04	-.08	-1.74	.08
Gender *(Female:1;Male: 0)*	-.09	-1.65	.10	-.01	-.27	.79
Model Summary: R Square (Adjusted R Square)	.05 (.04)			.07 (.06)		

(*English as mother tongue: 1; English as foreign or the second language: 0)

However, slightly different from the major analysis with the 1996 RAE, the positive perceptions of academic culture of social interaction from Chemistry students with English as mother tongue (Table 6-13) become insignificant here with the 2001 RAE.

Table 6-23 gives some details of intercultural facilitation of research for foreign doctoral students when the 2001 RAE is taken into account.

Table 6-23: Multiple Regression for Predicting Intercultural Facilitation of Research (for Foreign Doctoral Students) with 2001 RAE

Intercultural Facilitation of Research	Beta	T	Sig.
2001 RAE	.03	.60	.55
Subject *(Edu: 1; Che: 0)*	-.16	-3.19	.00
English as mother tongue*	.12	2.45	.02
Asian students *(Asian: 1; Others: 0)*	-.21	-4.41	.00
Year of study	-.08	-1.65	.10
Gender *(Female:1;Male: 0)*	-.02	-.45	.66
Model Summary: R Square (Adjusted R Square)	.13 (.11)		

(*English as mother tongue: 1; English as foreign or the second language: 0)

As might be expected, the 2001 RAE is not related to intercultural facilitation of research. Again, there is a disciplinary effect. Intercultural facilitation of research is more favourably perceived by foreign doctoral students in Chemistry than in

Education. Moreover, foreign students with English as mother tongue and non-Asian students are more satisfied with intercultural facilitation of research than foreign students with English as foreign or the second language, and Asian students.

Table 6-24: Multiple Regression for Predicting Research Training Programmes in Education and in Chemistry with 2001 RAE

Research Training Programmes	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
2001 RAE	.08	1.47	.14	.15	2.43	.02
Year of study	-.12	-2.22	.03	-.09	-1.48	.14
*Far East Asian students**	-.17	-3.04	.00	.01	.09	.93
Gender (Female:1;Male: 0)	-.06	-1.12	.26	-.08	-1.29	.20
Model Summary: R Square (Adjusted R Square)	.05 (.05)			.04 (.02)		

(* Far East Asian students: 1; Others: 0)

It is interesting to note that the 2001 RAE does not have any bearing on research training programmes in Education, but have a positive relationship in Chemistry. (Table 6-24) Similarly, it is only in Education that senior and Far East Asian students are less satisfied with research training programmes than junior and non-Far East Asian students. These findings again reinforce the main analysis in section 6.3.2.

Table 6-25: Multiple Regression for Predicting Research Facilities in Education and in Chemistry with 2001 RAE

Research Facilities	Education			Chemistry		
	Beta	T	Sig.	Beta	T	Sig.
2001 RAE	-.19	-3.42	.00	.23	5.44	.00
*Far East Asian students**	-.18	-3.19	.00	.01	.26	.80
Year of study	-.04	-.81	.42	-.02	-.40	.69
Gender (Female:1;Male: 0)	-.02	-.28	.78	-.02	-.50	.62
Model Summary: R Square (Adjusted R Square)	.08 (.07)			.05 (.04)		

(* Far East Asian students: 1; Others: 0)

The most striking fact in Table 6-25 is the disciplinary variations in research facilities. First, the 2001 RAE has a negative relationship with research facilities in Education, but it has a positive relationship in Chemistry. Second, it is only in Education that research facilities are less favourably perceived by Far East Asian students than other students.

The above findings of the four aspects of research environment for doctoral students with the 2001 RAE reinforce the main analysis in section 6.3.2.

6.4 Evaluation of Statistical Findings

In general, at the individual level of supervision, the findings of multiple regression confirm the analysis of simple regression in section 6.2.1 that the RAE has little bearing on supervisor's facilitation of learning, supervisor's accessibility and relevance of supervisor's research to that of students regardless of whether the samples are examined as a whole by holding other variables consistent or Education and Chemistry samples are individually analysed. This finding raises some questions such as: why is supervision in departments with higher RAE not perceived to be better? Why is a similar result found in different subjects? There are no easy answers to these questions. It could be because supervisors in departments with high RAE scores are so preoccupied with their own research performance rather than supervision for doctoral students that they do not commit themselves to facilitation of doctoral student's learning and that they are not available for students. It could also reason that effective supervision and research performance require two different types of people. Departments having staff who are good at one aspect do not mean they are good at the other. This will be further probed in the interviews and Chapter Eight.

Moreover, what is of interest is that the disciplinary differences between Chemistry and Education have a significant explanatory effect on the three aspects of supervision. Supervisor's facilitation of learning and relevance of supervisor's research to student's are perceived to be more favourable in Chemistry, whereas supervisor's accessibility is perceived to be more favourable in Education. It is probable that because Chemistry students' research is close to their supervisors' that Chemistry supervisors are more concerned about their students' learning than Education supervisors. Of course, it may also reason that Chemistry supervisors' facilitation of learning is through informal meetings with students while Education supervisors' way of facilitation is through formal meetings. It could be because Chemistry students have more informal meetings with their supervisors than Education students' formal meetings that Chemistry students are more likely to feel

supervisor's facilitation and concern about their learning. Meanwhile it could be because it is less common and more difficult for Chemistry students to have formal meetings with their supervisors than their counterparts in Education that Chemistry students are less satisfied with the accessibility of their supervisors. We may perhaps also assume that Chemistry supervisors are preoccupied with more tasks than their counterparts in Education such as finding funding for their large scale of projects or being industry consultants that they are less formally available for students than Education supervisors.

It is also noteworthy that senior studerts and Asian students are less satisfied with supervision in supervisor's facilitation of learning and supervisor's accessibility. This is perhaps due to different expectations between supervisors and senior students and Asian students. Of course, it could also reason that supervisors are more interested in junior students' projects which are new and exciting than senior students' projects which are old and possibly boring for some supervisors. Similarly, supervisors could find it is more difficult to communicate with Asian students for different kinds of reasons than students from other countries.

At the departmental level, the cumulative impression is that disciplinary differences play more important role than at the individual level in the relationship between the RAE and different aspects of research environment for doctoral students. The results therefore are more complex. In particular, the RAE appears to be not related to intercultural facilitation of research. However, the RAE has negative relationships with academic culture of social interaction in Chemistry and with research facilities in Education. On the other hand, it has positive relationships with research training programmes and research facilities in Chemistry. The overall multiple regression analysis with the 2001 RAE reinforces the main findings.

These findings raise many questions. For example, why does the relationship between the RAE and research environment for doctoral students at the departmental level have more disciplinary variations than it does at the individual level? Why does the RAE have a negative relationship with academic culture of social interaction in Chemistry but no relationship is found in Education? Why does the RAE positively relate with research training programmes in Chemistry, but not in Education? Why is

there a positive relationship between the RAE and research facilities in Chemistry, but in contrast a negative relationship in Education? Why is there no disciplinary variation in the neutral relationship found between the RAE and intercultural facilitation of research?

It is difficult to provide a full picture here. However, it will not stop us trying to make sense of these findings. The neutral relationship found between the RAE and intercultural facilitation of research could be because departments regardless of the RAE scores pay more or less the same attention to foreign doctoral students' learning. Next, as for the results of academic culture of social interaction, it may be because Chemistry students have closer involvement with the academic culture in the department than Education students. Therefore, when the departments are under great pressure to promote their RAE ranking leading to degenerating academic culture especially in departments with high RAE scores, Chemistry students are likely to be negatively influenced rather than Education students. The reason for the contrasting relationships between the RAE and research facilities in Chemistry and Education perhaps is that research facilities is shared between Chemistry students and staff in the departments, but not shared between Education students and staff. The laboratory in Chemistry may play a significant role here. The laboratory perhaps provides necessary space and a way to share the research facilities between students and staff. Therefore, when the departments with higher RAE scores have more funding to establish better-resourced laboratories, Chemistry students can also benefit from them.

The disciplinary variations in the four components of research environment for doctoral students are also of interest. Not surprisingly, Chemistry departments are perceived to be better than Education departments in most of aspects. Academic culture of social interaction, intercultural facilitation of research and research facilities are perceived to be better in Chemistry than in Education. This is perhaps due to the relevance of student's research to their supervisor's. As demonstrated in the analysis of supervision, Chemistry student's research is closer to their supervisor's than Education student's to that of their supervisor's. Also the presence of laboratories may provide a place to bring people together. Therefore, Chemistry students regardless of home or foreign students are more integrated into the department dynamics than their counterparts in Education. This leads to better academic culture

of social interaction, better intercultural facilitation of research for foreign students and better research facilities as perceived by students in Chemistry than in Education. On the other hand, research training programmes are perceived to be better in Education than in Chemistry. These findings will be further discussed in Chapter Eight.

The findings also reveal that, among the different groups in students, four aspects of research environment for doctoral students are perceived to be less favourable either by senior students in both subjects or by Asian students in Education or by both of them. It is interesting to note that among foreign students, Asian students in general are less satisfied with doctoral education at both levels of supervision and research environment than other foreign students such as European students. At the level of research environment, it shows that Education foreign students especially those from Asian countries are less happy with research environment than their counterparts in Chemistry. This may be because Chemistry foreign students with closer interaction with their supervisors and other staff in general are offered better opportunities to be part of the community, whereas Education foreign students with less interaction with their supervisors and other staff are given fewer opportunities to be integrated in the community. Furthermore, compared with other foreign cultures, the gap between Asian and British academic cultures is perhaps the largest. Therefore, taken in one way, Education Asian students compared with other foreign students can find it most difficult to overcome the cultural barriers to initiate two-way communication. From another view point, the British academic culture in Education can also find it difficult to bridge the two cultures and as a consequence least efforts are given to integrate Asian students.

As for the less satisfactory experiences of research environment shared by senior students than junior students, it could be because the departments in general regardless of subject pay more attention to junior students' needs rather than senior students'.

All the issues especially with regard to the relationship between the RAE and the effectiveness of doctoral education, and the disciplinary variations will be taken up again in the interviews and Chapter Eight.

Chapter Seven

Findings from the Interview Data in Education and Chemistry

One lesson to be drawn from the statistical analysis is that on the whole, the RAE ranking does not relate to effectiveness of doctoral education in either Education or Chemistry. A second lesson is that in many ways Chemistry departments are seen by their students to have better doctoral education than Education departments. In order to explore these findings further, eight follow-up interviews were carried out. In Chemistry most PhD students are members of a group working in laboratories, while Education students are pursuing individual research. The first part of this chapter explains how the interview data is analysed. The second section reveals the major findings from the interviews in both dimensions of supervision and research environment for doctoral students. It is followed by an evaluation of the findings.

7.1 Analysis of the Interview Data

The analysis of the interview data can be classified into two simple stages: generation of the interview report and categorisation. In the stage of creating the interview report, two steps are involved. First, a brief background summary is formed. It includes the sex of the informant, subject, domicile, English familiarity and general information such as the number of full-time PhD students in the department. The background summaries for all the eight informants are presented in Table 7-1. The Education students are all from different departments. The Chemistry students are from three different departments. Two students were selected from one department in order to examine a UK and foreign student's perceptions of a similar learning experience.

Next, the recorded interviews are mainly transcribed. In some exceptional cases the informants' words have to be interpreted. For example, in the cases of 'Yes/No questions' and 'Rating questions', their short answers are rephrased in the original

Table 7-1: Background Summaries for the Eight Informants

Education:

'A' is a male student who is in his fourth year of a full-time PhD course in Education. He is a home student with English as his mother tongue. He is the only full-time PhD student that his supervisor has. The Education department is in an old university with a high RAE score. There are about 30 full-time PhD students in this department. The interview was carried out one Friday afternoon in May in a quiet coffee shop.

'B' is a female student who is in her fifth year of a full-time PhD course in Education. She is from an Asian country where English is a foreign language. The Education department is in an old university with a high RAE score. There are about nine full-time PhD students in her specialised area. The interview was carried out one Monday afternoon in May in a quiet coffee bar.

'C' is a female student who is in her fourth year of PhD study in Education. She is a home student with English as her mother tongue. She was registered as a full time student when the questionnaire was administered. She is a part-time student now. C and her supervisor have been working on the same funded research project. The Education department is in a new university with a low RAE score. There are about 17 PhD students in this department. The interview was carried out one Monday afternoon in May in a quiet coffee shop.

'D' is a female student who is in her fourth year of a full-time PhD course in Education. She is a mature British student with English as her mother tongue. Because she has a teaching qualification, she also teaches in the department during her study. She was at a stage of waiting for viva when the interview was carried out. She is the first PhD student for her supervisor. The Education department is in a new university with a low RAE score. In this department, there are about five or six full-time PhD students, fourteen members of staff and six of them are research active. The interview took place through the telephone a Thursday evening in June.

Chemistry:

'F' is a male student who is in his third year of a full-time PhD course in Chemistry. He is from a country in South America with English as a foreign language. The Chemistry department is in an old university with a high RAE score. There are about 10 active members in F's group including the supervisor, postdocs, a Master student, final year project students and five PhD students. The interview was carried out one Wednesday morning in May in a quiet coffee shop.

'G' is a male student in his third year of a full-time PhD course in Chemistry. G is from a country in North America where English is the native language. The Chemistry institution is in an old university with a high RAE score. There is one professor and five PhD students in G's group. G works closely with 2 other professors, 6 post-docs and 13 PhD students. The interview was carried out one morning in May at a coffee area shared by both staff and graduate students in the G's institution.

'**H**' is a male student who is in his fourth year of his Chemistry PhD study. He is a home student with English as a native language. The Chemistry department is in an old university with a low RAE score. There are about 25-30 PhD students in this department; 12-15 students on the same floor of the research laboratory and 3 in his group under the same supervisor. The interview was carried out one morning in May in a quiet coffee shop.

'**J**' is a male student who is in his second year of his Chemistry PhD study. He is from a European country where English is a foreign language. The Chemistry department is in an old university with a low RAE score. There are 60 postgraduates and postdoctoral research workers in this department. Among them, 12 PhD students and two postdocs are on the same floor and six in his group under the same supervisor. There are 22 full time members of academic staff. The interview was carried out one Saturday afternoon in May in a quiet coffee shop.

sentences. Take question A1 for instance:

> A1. Do you feel PhD students are treated as full members of the research community in your department/ group?
> ❒ Yes. → A1.1 To what extent? For example?
> ❒ No. → A1.2 For example?
>
> (Appendix 4)

If the informant's answer to A1 is "No", it was rephrased in the original question, for example in Case One:

> 'A' does not think PhD students are treated as full members of the research community in the department.

It is then followed by the question A1.2 to elaborate it. When the response of the informant is too long or repetitive, it was necessary to give a summarised interpretation.

The interview reports were sent back to those interviewees for feedback and have been modified according to their wishes and received their full consent.

In the second stage of categorisation, each report is clustered into two main sections: Supervision and Research environment for doctoral students. Each section is further divided into three sub-categories as follows: (Table 7-2)

Table 7-2: Categories of Interview Reports

A. Supervision	*B. Research Environment for Doctoral Students*
• Relevance of supervisor's research to student's • Supervisor's facilitation of learning • Supervisor's accessibility	• Research resources • Institutional facilitation of research • Institutional dynamics

Questions related to the same sub-categories are clustered (Table 7-3). Information given by the eight informants is put together under these categories. Two examples of the clustered data are in Appendix 13. One is the section of "Relevance of supervisor's research to student's" under the category of Supervision. The second is the section responding to the question of whether doctoral students are treated as full members of research community in "Institutional facilitation of research" under Research environment for doctoral students.

Table 7-3: Clustering of the Interview Questions

A. Supervision	
Relevance of supervisor's research to student's	B1. Do PhD students and their supervisors in your group/ department work as a team on the same research project? ❒ Yes. ❒ No. → B1.1. How do they work?
Supervisor's facilitation of learning	B4. To what extent do you think that PhD students in your group/ department regard their supervisors as a working colleague? (from 1-10: 10 as very much as a working colleague) → B4.1. Why? C1. Do you think the supervisors in your group/ department are supportive to their PhD students? (academic support) ❒ Yes. → C1.1. How supportive? (from 1-10: 10 as very supportive) ❒ No. → C1.2. Why? C6. During the process of your PhD study, do you feel you have been neglected by the supervisor? (supervisor not interested) ❒ Yes. C6.1. For example? ❒ No. C6.2. Do you think this is typical to other students in your group/ department? ❒ Yes. ❒ No. C8. During the process of your PhD study, do you feel any part of your ideas or efforts or labour have been exploited in a negative way? ❒ Yes. → C8.1. For example? ❒ No. C8.2. Do you think this is typical to other students in your group/ department? ❒ Yes. ❒ No.
Supervisor's accessibility	B2. How often in general do PhD students in your group meet their supervisors? ❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒

	once every month. ❒ other: B2.1. How often do you meet your supervisor? ❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month. ❒ other: B3. Do you need to make appointment before the meeting?❒ Yes. ❒ No. B3.1. Do you think this is typical of other PhD students in your group/ department? ❒ Yes. ❒ No. B5. How often do PhD students have the opportunity for informal interaction with their supervisors in your group/ department? ❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month. ❒ other: ❒ very difficult or almost no informal interaction B6. How would you describe the interaction between students in your group/ department and their supervisors or you and your supervisor? (from 1-10: 10 as strongest sense) __ sense of partnership / common purpose (working as a team, working together) __ sense of distance __ sense of hierarchy
B. Research Environment for Doctoral Students	
Research resources	C2. How supportive is the department/ group as a whole to PhD students' research? (technical, administrative, resources) (from 1-10: 10 very supportive) C2.1. For example?
Institutional facilitation of research	A1. Do you feel PhD students are treated as full members of the research community in your department/ group? ❒ Yes. → A1.1 To what extent? For example? ❒ No. → A1.2 For example? A1.3 Why is that? A1.4 Rate from 1-10: 10 as full member. C7. In your doctoral study, do you feel that PhD students' research is neglected by the group/ department as a whole? (not care PhD students, not listen to PhD students' voices) ❒ Yes. C7.1. How? ❒ No.
Institutional dynamics	A2. How often do PhD students have the opportunity for informal interaction with staff in your group/ department? ❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month. ❒ other: ❒ very difficult or almost no informal interaction A3. How would you describe the general interaction between staff and students in your group/ department?(from 1-10: 10 as strongest sense) __ sense of partnership / common purpose (working as a team, working together) __ sense of distance __ sense of hierarchy C3. During the process of your PhD study, do you feel isolated? ❒ Yes. → C3.1. How much? (from 1-10: 10 as very isolated) ❒ No. C3.2. Do you think this is typical of other students in your group/ department? ❒ Yes. ❒ No. C4. During the process of your PhD study, do you feel separated / cut off (from other students or the supervisor)? ❒ Yes. → C4.1. How much? (from 1-10: 10 as very separated) ❒ No. C4.2. Do you think this is typical of other students in your group/ department? ❒ Yes. ❒ No.

	C5. During the process of your PhD study, do you feel lonely? ❒ Yes. → C5.1. How much? (from 1-10: 10 as very lonely) ❒ No. C5.2. Is this typical to other students in your group/ department? ❒ Yes. ❒ No. C9. Have you enjoyed your study so far? (student's life and learning experience) ❒ Yes. ❒ No. C9.1. from 1-10: 10 as very enjoyable C9.2. Do you feel other PhD students in your group/ department enjoy their studies? ❒ Yes. ❒ No. C9.3 Will you recommend your group to future students? ❒ Yes. ❒ No.

7.2 Results of Interviews

7.2.1 Supervision

7.2.1.1 Relevance of Supervisor's Research to Student's

Regardless of the RAE scores of departments, all four informants in Education share similar views that the majority of the PhD students (and themselves) do not work on the same research project with the supervisors, although C was working with her supervisor on the same funded research. Supervisors and PhD students have shared areas of academic interests, but in most cases, their research projects are not related. (C & D) The typical example is, "He [the supervisor] has his own research which is not the same as mine. He doesn't look at higher education. He doesn't look at the process of socialisation and profession. In that way, his work is very different from my work, although he helps me with mine." (A)

On the other hand, all four informants in Chemistry share the same view that PhD students and their supervisors work as a team on the same research project. For example, "You have to [work as a team]. That is the definition of a research group. The research group will fall apart if there wasn't a team. Without a team, this type of structure just wouldn't work." (G) "Almost a hundred percent of students work on what their supervisors tell them to work on. That's not to say they can't be creative and try things out and move around bit and confine the project, but the goal is the same." (H)

7.2.1.2 Supervisor's Facilitation of Learning

With regard to the supervisor's role, three informants in Education share the same view that PhD students do not regard their supervisors as working colleagues in the department. Two of them, A and B, are from departments with high RAE scores and one of them, D, is from a department with a low RAE score. For example, D says, "for me, no. I just don't think I have ever been taken seriously as a working colleague. ... I don't think as a research student, ... ,you know, we are not at the same level as the supervisor." (D) "A supervisor is a supervisor." (B) The only exception is A, who treats his supervisor as a colleague but not a working colleague. "I think I would regard mine as a colleague, not as a one-to-one colleague, but very close. I am not sure about the working part of it, because we don't really work together or anything." (A)

In Chemistry three informants, H and J from departments with low RAE scores and G from a department with a high RAE score, state that they regard their own supervisors as working colleagues. J explains that it is due to the nature of the research group, working on the same project, that brings people together. Finishing the project becomes the only goal that all members of the group aim for. "Of course we all know that our supervisor is our boss. On the other hand, we are all in the same boat. We all want to get the research done. Of course we have slightly different aims that we want to go to, such as, I mean, interests of the research, publications and academic processes." (J) It is also to do with the general atmosphere of an open, casual and equal communication between students and the supervisor, which contributes to the sense of collegiality. (J) H regards his supervisor as a working colleague, too. "He [H's supervisor] is very good at some things and I am very good at some things. Between us we make a good team." (H) G gives a more progressive view: compared with earlier stage, the supervisor is regarded more as a working colleague than a supervisor at a later stage. "Once you have established yourself, it is much more sharing and equal: sharing and equal as you get older." (G) On the other hand, F thinks that "if we consider PhD as a job, he [the supervisor] is the one who employs you. He is the one who decides when you can submit your thesis and the one who evaluates your work. Some people even have fear when they have to talk to him [the

supervisor]. It is more like a boss-employee relationship." (F) It is echoed by H that some students may treat the supervisor more like a "boss" than a working colleague.

Concerning supervisor's helpfulness, supervisors are seen to be supportive to the informants' research in Education regardless of the RAE scores. However, B in a department with a high RAE score feels that her supervisor became less supportive at a later stage such as data analysis than at the initial stage. Although she can work quite independently at the present stage, the supervision is regarded as not adequate in terms of the input, the feedback and guidance she receives. For the issue of supervisor's neglect and exploitation, B finds that supervisors are seen to be passive and "un-interested" in relation to students' research. "The impression that students have is that supervisors try *not* to involve themselves in students' work. They are concerned but not involved. ... Supervisors in this department do not fulfil their duties and do not have genuine interest and concern toward students' work." (B) Also, "there is a lack of pastoral care." (B) Similar feelings are shared by C and D, who are from departments with low RAE scores. C does not feel academically neglected by the supervisor, but she feels neglected at the level of human interaction with the supervisor - the emotional side of the academic study. For example, there were periods of time when B suffered a bereavement and when she was busy for two wedding ceremonies. "There is no way that she [the supervisor] could accept that these things might actually reduce my effectiveness. I was surprised that somebody just brushes it off as if ...Well, this kind of things goes on in your life. She [the supervisor] would expect you to be able to cope this kind of things without actually showing." (C) It has made C feel that it is unprofessional to raise these issues to the supervisor. The emotion side of the academic study is totally ignored. The supervisor is described as "unsympathetic." (C) D feels that her efforts and ideas were exploited in a negative way by the supervisor at an occasion when a joint paper was published but without D's name. The only exception is A from a department with a high RAE score, who thinks he is neither neglected nor exploited by the supervisor.

In Chemistry, all informants regardless of the RAE scores of the departments perceive their supervisor as supportive. For the issue of neglect and exploitation, two of the informants do not feel neglected or exploited by the supervisor (F & J), but several issues are raised. In the first instance, although F (from a department with a high

RAE score) does not feel negatively exploited by his supervisor, he points out that some students can feel that way because they are asked by their supervisor(s) to sign the contract that "they [students] can only have one Sunday free in a month and they do not even have bank holidays." (F) In some cases, "they [students] have to work really long hours and almost no weekends." (F) Some students are treated as "hands of their supervisors" to do the "dirty jobs" in the lab for them. (F) Similar issues are raised by H in a department with a low RAE score. H feels "a little bit" exploited when his supervisor passed some of his own administration and teaching to him.

> My boss is trying to minimise his administration and I often find myself the things to do that a secretary might be better to do photocopying... It is not really exploiting my research skills but my good will, I suppose.
>
> (H)

F also highlights the exploitative nature of publication culture in Chemistry. For example, the supervisor and F are asked to include the names of the industrial sponsors as the authors in their publications of the research results even though the sponsors do not have any academic input at all.

Next, the issue of supervisor availability was raised twice, by F and H. F who is from a department with a high RAE score thinks that supervisors are too busy in engaging with their own jobs, such as teaching, writing research proposals and getting funding, to be with their students. Although F catches sight of the supervisor every day, there are not many opportunities for formal discussions. Supervisors are seen to pay more attention to the management side of the research projects instead of to the actual research jobs carried out in the laboratory. As a result, the interaction is not as frequent as students want. For H from a department with a low RAE score, his supervisor has been abroad during a third of the time in a year. He feels neglected when his supervisor is not in the country. "That's quite significant, I think. Two months without face-to-face contact." (H) On the other hand, most of the time, G from a department with a high RAE score thinks that his supervisor is available. He can just go over and have a talk with him. It is very typical of other students in G's group.

Moreover, F and J accentuates the issue of laboratory guidance. Students are left to work alone in the laboratory. There is not much practical guidance there from the

supervisor and almost no alternative guidance in the laboratory. "He [the supervisor] hasn't been there to supervise the first step in the lab. Sometimes it is a bit scary." (F) "Some supervisors hardly do the experiments or visit the laboratory." (J) Similar feelings are shared by G, who is from a department with a high RAE score. G states that "a couple of times" he was neglected by the supervisor at the beginning. G's Supervisor did not give enough attention to his research. G supposes that it could be because "it is tough getting going and getting into it." (G) It is also perhaps related to supervisor's supervising experience. "He [G's supervisor] is a young staff member who hasn't had a lot of graduate students. So it is a training process for both sides. He is a lot better than he was when I started." (G)

7.2.1.3 Supervisor's Accessibility

Informants from Education regardless of the RAE scores all meet their supervisors regularly from once every ten days to once every month. Formal appointments are required for the meeting. Two of them said that the next appointment is made by the end of one session. (A & D) It is shared by all of them that it is difficult to have informal interaction with the supervisor.

Three of the Education informants (two from high RAE departments and one from a low RAE department) think that there are not many opportunities for informal interaction between supervisors and their students. (A, B & D) "For me, I assume probably the same for others, probably one of the major time to interact outside the specified meeting is those seminars. Maybe have a quick chat there." (A) B thinks that it is because supervisors are too busy to be available for students. D points out the lack of "natural interaction" between the supervisors and students. She reasons that students need to have a more supportive and secure environment so that they can be more open to share opinions with others.

> I don't think our department has high degree of interaction. I think that goes back to the ground we are dealing with: it's difficult and you are just not going to bump into them. And therefore, you cannot develop those functions. You would develop with people whom you bump into at early morning, at 10 o'clock, right? They're bumping out. Then you could have a laugh, a chat, whether the weather is fine, whatever. I mean that's the way you interact with people. And that goes first and then you

interact with them on the level of kind of research agenda. 'I am a research student. How do you think ...' You need to feel a little bit secure before you into that to talk about your research if you don't know them very well. And I think that's a very important aspect. But you need to feel secure before you talk about it. I think that's one of the most important things that you have a, what I would call, the natural interaction with them.

(D)

The only exception is C, who works on the same research project with her supervisor. They have meals and go to conferences together.

In contrast, informants in Chemistry reveal different types of supervisory dynamics. All of them despite the different RAE scores of their departments point out two kinds of meeting with the supervisor: one-to-one and group meetings. A group meeting is formal. It is called and organised by the supervisor once a week. (Only in the case of H from a department with a low RAE score, it is held once every month or once every two weeks.) On the other hand, the one-to-one meeting is less formal than a group meeting. G, H and J can have one-to-one meetings whenever they want or at least once a week. They can just walk in the supervisor's office, present the results and have a short talk for about twenty minutes. Sometimes if they need to make appointment, it is also informal – simply knocking on the door. The only difference for F is that he needs to knock on the door every time before the one-to-one meetings.

There are plenty opportunities for G, H, J and F to have informal interaction with their supervisors. No variation of the RAE scores is found. It usually happens on a daily basis. "People have coffee and tea and you can literally spend a couple of minutes while the kettle is boiling as an informal discussion, interaction." (H) "We all on the same floor. Most of the area is quite large and quite open. So you run into each other sooner or later." (J) F can have a cup of tea with his supervisor once a week or once every fortnight.

7.2.2 Research Environment for Doctoral Students

Different from Education students, Chemistry students are seen to relate differently to the academic groups, laboratories and departments. In most cases, a Chemistry department has more than one laboratory. Within each laboratory, there are different research groups. Each group usually led by one supervisor includes various numbers of full-time PhD students. If the research project is on a large scale, a group sometimes can also involve several postdocs, master students and final year project undergraduate students. Chemistry students associate most closely with their own groups, then laboratories and the least departments.

7.2.2.1 Research Resources

Two informants (B from a department with a high RAE score and D from one with a low RAE score) in Education think that the department is supportive in physical resources. Having said this, C from a department with a low RAE score thinks that the department only provides the minimal support. Furthermore, B from a high RAE department is not satisfied with the research training courses offered by the department. The quality of the research training courses is not satisfactory and is described as "waste of time." (B) B states that "I attended all the compulsory courses as required but a few students I knew had found it useful".

In Chemistry, two informants perceive that the department is supportive in administration (J from a department with a low RAE score), equipment and physical space (F from one with a high RAE score) and literature and technique consultation (J & F). H (from a low RAE department) does not think the department is supportive in providing equipment and laboratory space. On the other hand, G (from a high RAE department) states that he does not have much contact with the department.

7.2.2.2 Institutional Facilitation of Research

Three informants in Education (A and B from departments with high RAE scores and D from a low RAE department) think that PhD students are not treated as full members of the research community. The difficulty for research students to be part of the community, according to D, is due to the strong and exclusive nature of the staff network. Staff are seen to stick with their own community which is more permanent and familiar for them. "I believe it is to do with the fact that the tutors, the research tutors, and people who are teaching and members of the staff, as opposed to research students, they already have a community in which they interact." (D) One of the things that manifests this difference between the staff community and research students is:

> You didn't necessarily bump into other members of the research group at the free time. You have to make the appointments to go and see either your own supervisor. You are never *part* of that department. You never got involved in sort of more ... I mean, it doesn't mean to say you won't ask to come in or you couldn't be in the department, but I'm always a bit of an outsider.
>
> (D)

D further elaborates the distinction between staff and research students. "You might be part of the community in terms of the research students. But you don't share those other trials and tribulations of being employed by that department, by that university. I think they are very important mechanism before creating either an inclusive or even a divided community, but nevertheless you are part of the particular set up. And I think research students are not part of that." (D) Similar feelings of exclusion are expressed by B. B thinks that students are treated as "2nd class citizens", especially for foreign students. "If you had not worked in the UK, and presumably did not know 'their system' or if you do not speak English as a first language you would not know the hidden meanings in some of their expressions." (B)

A thinks that the discrepancy in the treatments between the staff and PhD students is caused by the "power imbalance based on the amount of knowledge". (A) The only exception is C (from a department with a low RAE score). She feels treated as a full member of the community. She thinks that it is due to her age and experience – a

mature student. However, she admits that the majority of students who are younger than her are not treated as full members of the community. (C)

All the Education informants regardless of the RAE scores think that PhD students' research is neglected to some extent by the departments. (A, B, C & D) A thinks that this sense of neglect is caused by staff's general ignorance about the work of PhD students. "I know that there are two others, one professor and one doctor, who know about my research quite well. But then I *doubt* if many of the others know ... So it's neglected in that way – in the general awareness, I imagine, what PhD students are doing." (A) The same view is also shared by B. She thinks that many academic staff do not have any idea about students' research projects or even students' names. Students are known only under the category as "research students" and not as individual persons. (B)

D thinks that the department does not treat PhD students' research seriously because it is not part of the RAE evaluation:

> I think it is neglected up to the point at which you are fortunate enough to have your doctoral study going further and you are in position to write research papers. Then I think you begin to be important to them because it all counts towards the RAE score. But I think until you can contribute to that RAE score, you are not important. You may well attend the conference, you may even write the paper, but it has not got the same ... it doesn't count for anything. Until the moment you can be included into their score, then it has some relevance.
>
> (D)

C thinks that the department's commitment to undergraduate teaching distracts its attention from PhD students' work.

In contrast, all the four informants in Chemistry think that PhD students are treated as full members of the community. (F, G, H & J) No variation of the RAE scores is found. Among them, G has a developmental view. He thinks that junior students are less treated as full members than senior students. "By the second and third year, they [students] have got more background information and they are basically the experts in the field in the department." (G)

F differentiates the levels of group and department. Students are treated as full members in the group community but much less so in the department community. This is because PhD students who are involved in the teaching activities at the departmental level are treated as doing "dirty jobs" for the staff. "Dirty jobs" means "within these teaching duties we were sometimes given the more laborious ones and the least interesting: such as marking and demonstrating." (G) "We are never asked about the schedule. We are just given a schedule." (G) The same issue is also raised by student H, who feels treated as "cheap labour":

> My own PhD studentship is called 'Graduate teaching studentship' which means it's over four years, not three years. And I am employed by the college as a teaching assistant to do like practices and tutorials, some lectures sometimes. So the only benefit for the college is that they get a member of staff for four years who does all the bad bits of teaching and you only have to pay them nine thousand pounds a year. Whereas if you get a junior lecturer, you have to pay much more. In that sense, yes, I think it is cheap labour. ... Yes, PhD students are very cheap, very good value for money for the research. If you want to research for academics, it's very cheap to have a PhD student and not very cheap to have a postdoc.
>
> (H)

However, at the group level, there is mutual respect between students and their supervisor. (F) The supervisor is very open to students' ideas. The interaction between the two is active. They discuss things on the equal basis. Students' opinions on the research project are valued. It is shared by J. According to J, students' opinions are very valued especially in the group. It is this sense of cherishing students' ideas that makes J feel being treated as a full member of the group. For example, "if there is an academic problem, question of research or whatever, it is quite obvious that in our group especially, not so much in the department, we used to have regular group meetings anyway, everybody is encouraged to speak their minds." (J)

None of the informants in Chemistry, despite the different RAE scores of their departments, think that PhD students' research has been neglected in the department. They share the same view that PhD students are those who actually do the research in the department. H explains the reason why PhD students research is greatly valued by the department and how it helps incorporate PhD students as full members of the community. He illustrates that the department research carried out by each group

heavily depends on PhD students. It is not only the large number of PhD students but also "the way that people really rely on their PhD students. There are *many many* groups they don't have any postdocs so PhD students are really the labour in the group to all the work. So they are very important as such that they are really integrated." (H) He further highlights that PhD students research is "definitely not [neglected]. Because, as I described they [the staff] really rely on PhD students' work, man power, labour. If it wasn't for them, it wouldn't have any research." (H) It is echoed by G: "Because this [PhD students' research] is the basis for the departmental and group research." (G)

7.2.2.3 Institutional Dynamics

All the Education informants think that it is not easy to have informal interaction with staff in the department. (A, B, C & D) No variation of the RAE scores is found. "Meeting up with people [academic staff] can be quite an obstacle." (C) For D, the informal interaction with staff in the department is "virtually not at all." (D) This is because "the college in fact set up a graduate school, like a graduate building. We were meant to work over there. So we were totally detached from the department." (D) For A, the informal interaction with staff "is not that often just because as considering the building you don't necessarily bump into them or see them. More often they are in their office or they are out to do something else." (A) There is a common room in A's department, but it is "just for researchers, rather than PhD students." (A) B thinks that although there are some opportunities for informal interaction between academics and PhD students through social events organised about once a term, the efforts that tried to bridge the two parties are more from the side of students and much less from the staff side. "It is very much depending on *we* pushing ourselves to interact with them. Academic staff are seen to be not interested in knowing students." (B)

There is little sense of partnership between students and academics in the Education departments regardless of the RAE scores. For C, the general atmosphere is pleasant and friendly, but somehow underneath it, the communication is one-way and there is a feeling of isolation from other researchers:

> The case is always like if I want something, I have to go and find somebody and say 'I wonder if you can help me on this particular instance'. It is not partnership. It is only open doors. It is not always open anyhow. It is very one-way. As I could say, it is very isolated.
>
> (C)

In addition, staff are seen to be "uninvolved" in students' research. Similar feeling of the lack of partnership is shared by D:

> I don't think there was any partnership or team approach. I don't think I ever felt. Apart from seeing my own supervisor, I don't think anyone else is interested at all. It's sort of lack of interest. My department was not following a collective approach to research. It's very individual quite sort of stand alone piece of research. And therefore it inevitably makes the difference. Our overall subject area is Education. But within that broad umbrella of Education, people are pursuing very individual type of pieces of research.
>
> (D)

There is no disparity in the departments of the low and high RAE scores in the sense of hierarchy. All the Education informants think that the sense of hierarchy in the department is strong. (A, B, C & D) The sense of distance between students and academics is perceived to be strong by B (from a department with a high RAE core) and D (from a low RAE department). With regard to the sense of hierarchy, C thinks that "as a student you have to be very careful which person you ask first. You don't go straight to the top. You have to go through the correct steps." (C) A gives an example:

> There is definitely, yep, a sense of hierarchy between professors, doctors and PhD students, I would say. I guess that might come across through the, um, one of our professors who is head of science education, a professor. And all his lectures sort of, you know, you walk around and know he is a professor. He has this kind of *status*, the top dog, the number one man. That's the impression I get from interaction with him and doing the seminars and things.
>
> (A)

Similar example also given by D regarding the sense of distance:

> There were joint seminars. Sometimes it would be a student that was giving the seminar. Sometimes it would be a member of staff giving the seminar or presenting a piece of research work. That's one of the occasions when staff and students were meant to come together. But what we count was that quite often staff just didn't turn up. It was seen by research students, it implies that research students must turn up at the seminar. But it's up to staff whether they turn up or not. And often they would say, 'Oh, I can't come. I am too busy. I've got whatever it is to do.'

> Always there would be some members of staff who would turn up. But quite often what happened was if it was a member of staff given a research paper, then you get bigger percentage of staff. If it was a student to give a research paper, often you would find there wouldn't be that many. And therefore you get that sense of 'Oh, they obviously don't think turning up to mine as a research student is worth it.' They don't set out to do that, but you feel what you are up to is undervalued.
>
> (D)

For the reason why the partnership is poor, and sense of distance and hierarchy is strong, D explains:

> The problem is that you just are not there. You are not part of the everyday surrounding and therefore the interaction is low. You only go if you're going to see your supervisor. And therefore, I don't think you make any interaction generally. I think it's very easy to feel very isolated and not particularly feel part of the community. (D)

All the Education informants regardless of the RAE scores think that doing a PhD is a very isolated, separated and lonely process. (A, B, C & D) For example, D feels isolated because of the individualist nature of Education research:

> It's not only the physical reasons that we talked about but also the fact that where I am we have very individual pieces of research. That's another isolating factor. I think at the end of day, doing a PhD is very isolating. For me, there is no community. Physical distance, the fact that everyone is pursuing individually a very particular piece of research: there is no community of research; there is no joint research, no department research. Those are quite isolating factors. And therefore I think for me it has been a very isolating, very lonely kind of existence. Can I use a metaphor? It's a bit like being in a boat paddling yourself. There is no one else in the boat with you. You kind of paddle along on your own.
>
> (D)

For the same reason of the individualist nature of Education research, A feels lonely.

"The fact that I'm working on something that only one of the PhD student's working on. He is not actually working on. He is just in the same field of science higher education. It ends, because none of the lecturers, it's none of their main interests. So in that way it's a lonely process." (A)

C feels separated mainly owing to the lack of social interaction even though she was working on a piece of funded research with other academics.

> I was fortunate that I did a piece of funded research with another person. Therefore I knew some people... I was able to work with

> somebody. Otherwise, I've got to know nobody, except occasionally introduce myself to people. ... There is never any social interaction. I don't think anybody really worries about how difficult I might have found it there. There is no social care. Meeting with other students is very rare.
>
> (C)

For students in Chemistry, it seems that there are three different levels of institutional dynamics: group, laboratory or floor and departmental levels despite various RAE scores of the departments. The group interaction is much more important than the departmental interaction. "Of course, the group has the most considerable influence, because that is my supervisor's group." (J) Three informants in Chemistry (G from a high RAE department; H and J from low RAE departments) think that it is very easy to have informal interaction with academics especially at the group and laboratory or floor levels. For example, G states that "You can meet them [academic staff] right away for whatever reason. I wouldn't have a problem talking to most of them, staff members, in a couple of hours later or the next day." (G) The access to the academic staff is "fairly immediate; there isn't a sort of long waiting time." (G) For H, the information interaction between staff and students are described as "very often, certainly on the floor that I work on." (H) "We have sort of tea and coffee time when you can quite easily talk to academic members of the staff or other students over a lot of things". (ibid.) The staff's attitude is described as "approachable", "friendly" and "quite receptive". (ibid.) J shares the same opinion. "It is as often as they [students] like." (J) The social contacts between staff and students happen on a daily basis. More importantly, it is two-way communication. J and staff consult each other for different matters, even though they are not in the same specialised area. (ibid.)

All Chemistry informants perceive that there is little sense of distance and hierarchy but good partnership among staff and students. (F, G, H & J) There are no differences between departments with the low and high RAE scores. For example, the feelings of partnership are attributed to the good interaction and strong sense of teamwork in H's group. "Certainly the groups that I have most interaction with myself on the same floor of my building. We work together very well as a team, even if we haven't got the same research aims or goals. People do favours to other people. I can do favours to people." (H). Also, the relationship among graduate students is very close and supportive in a group. (G) The overall atmosphere of the group is described as

"frankly helpful and ebullient". The cooperative spirit of the group is illustrated in this example: "I will try to do the best as much as I can to help each other to succeed. There is not a lot of competition among graduate students. They are willing to put down their stuff to help each other out. That is what I have seen so far." (G)

The lack of hierarchy, for G, is because most of the staff are young and "personable": approachable, easy going and easy to talk to. It is also because "quite of few of them [academic staff] they actually want PhD students to learn and take away as much education as possible. They realise that having a sort of very hierarchical structure is not conducive for students' learning." (G)

The lack of distance between staff and students is depicted by J in an example about the news of the pregnancy of the wife of his supervisor, which is shared and concerned by the whole group. "My boss' wife is pregnant about a month ago. We're *all* surprised. We're *all* excited. ...It's like, um, 'when does it come close?' 'Oh, calculate the birthday' 'Is she doing all right?' ... You know what I mean. Everybody is in that." The atmosphere in the group is very warm. People feel close to each other. (J)

The only exception is F who is from a department with a high RAE score. He thinks that there are not many opportunities for informal interaction with staff in the group. For example, students hardly run into staff in the corridor. It is also rare that staff and students have a chat over a tea break. It is about once a month that the whole group including the supervisor gets together to have a dinner or visit someone's place. The lack of informal interaction can be because there is no common room in the group, laboratory and department. It also results in the strong sense of distance and hierarchy, and the absence of partnership between staff and students.

With regard to whether PhD study is an isolated, separated and lonely process, first of all, three of the informants (two from departments with high RAE scores and one from a department with a low RAE score) in Chemistry do not think that it is an isolated and lonely process. (F, G & J) However, all of them regardless of the RAE scores point out the teamwork structure of the group, which helps overcome the isolation and loneliness of the PhD studies. (F, G, H & J) G from a high RAE

department reveals, "it is the group structure. There are always people you can talk to about things. People are pretty open about helping the others' problem." (G) 'People' here means the group members, staff and postdocs. "People talk among themselves. If things go bad, you will try to help them out. So the group is pretty important." (ibid.) The close relationship among the group members in a laboratory is manifested when F refers to people working in the same laboratory as "labmates". They are doing the same or similar research projects so that things or problems can be discussed together. (F) It is shared by J from a department with a low RAE score. "There is this kind of general depression about PhD study. But I do not feel isolated. There are people around you. You talk things together, help each other." (J) However, compared with home students, foreign students are more likely to feel isolated. "Their first time in a foreign country. They do not have the social network. They may feel homesick." (J)

The only exception here is H: he feels isolated and lonely during his PhD study. This is related to the size of his group. "As the group gets bigger, the sense of isolation gets less." (H) Compared with other groups, H's group is small with only one supervisor and three students. "Other groups are bigger, five or six students in the group. That's much better, because they sort of share greater sense of common ideas. They feel less isolated certainly." (ibid.) For the loneliness of PhD study, he thinks that "intrinsically PhD research is quite a lonely process, because if you compare to a degree course, an undergraduate degree course, you really have lots of colleagues studying the same thing you have everyday. You go to the same lectures; you take the same exams at the end of the year. But with the PhD, you are the only person who is studying the thing. Well, you have people maybe in the same group as you studying things which are similar, but not studying *the same* thing. So I think it is quite solitary." (ibid.)

For the feelings of separation or cutting off from other students or the supervisor, none of the Chemistry informants feel separated. (F, G, H & J) No variation of the RAE scores is found. All of them attribute the absence of feelings of separation to the close and good interaction among the members in the laboratory. It is because "I see my labmates everyday and the supervisor, too" (F) "We [students] have lunch together at least twice a week. There is a lot of social interaction. We went to the pub

quite often on Friday nights." (J) For H, it is partly due to the good interaction with his supervisor; more importantly, it is associated with the structure of the laboratory. "I think it is because of the way our laboratory is organised. Like I said, there are five or six groups that share the same space so this helps the interaction." (H) Moreover, "It [the lab] can help if you experience the problem is slightly outside of your own field technically." (H) For G, although there is geographic distance between his supervisor's office and the laboratory where students work, "it is not really an issue". (G) This is because there are group members around to share things, talk and help each other.

7.3 Evaluation of Interview Findings

The general findings from the interview data not only reinforce the statistical findings from the questionnaire but also provide some insights into those findings. Firstly, the learning experiences of all the informants in both subjects are not seen to greatly vary between departments with low and high RAE scores. At the level of supervision, all the Education informants regardless of the RAE scores point out that it is not common for students to work on the same research project with the supervisors. The interaction between Education students and their supervisors does not lie in a spirit of collegiality and is usually formal. The lack of the RAE variation is also found in Chemistry. Even though, Chemistry students' experiences are very different from that of Education students. All the Chemistry informants despite the different RAE scores of their departments indicate the importance of working as a team in a group. It is almost no exception that students and supervisors work on the same research projects. It is common for Chemistry students to have informal and frequent contacts with their supervisors who are regarded as working colleagues. Having addressed this, the possible exploitation of PhD students' labour or publication culture in Chemistry is raised by an informant from a high RAE department. The issue of supervisor availability is also addressed.

At the level of research environment, similarly, there is no significant disparity in students' experiences related to the RAE scores. Education informants in general feel that PhD students are not treated as full members of the research community. It is shared by all the Education informants that PhD student's research is neglected by the department. The reason as shown is that the RAE evaluation does not take account of PhD student's research. All the Education informants, regardless of the RAE scores, point out that it is not easy to have informal interaction with staff in the department, which leads to the high degree of hierarchy, distance, and the absence of partnership. PhD study is perceived to be a very isolated, separated and lonely process by all the Education informants without the variation of the RAE scores.

As expected, there is no RAE variation of students' experiences at the level of research environment for doctoral students in Chemistry. What is of interest is that Chemistry students' experiences are very distinct from that of Education students'. It

is shared by all the Chemistry informants despite the various RAE scores that PhD students are treated as full members of the community. It is especially so in their 'groups'. Chemistry departments regardless of the RAE scores treat PhD students' research seriously, because PhD students are those who actually carry out research projects in the departments. Moreover, there is no indication of RAE variation in the institutional dynamics. It is widely shared that it is very easy to have informal and casual interaction with staff in the groups, laboratories and departments. The good interaction between academics and students in Chemistry departments lies in good partnership and the lack of hierarchy and distance. It is two-way communication. Chemistry PhD study is *not* perceived to be an isolated, separated and lonely process regardless whether it is in the departments with low or high RAE scores. It is due to the mutual support shared among the members of the research groups in a laboratory.

Secondly, as summarised above, it shows that what differentiates doctoral students' learning experiences is subject of study. Doctoral education as experienced by Education and Chemistry informants is seen to be different in all three aspects of supervision and research environments for doctoral students. The possible reasons underlying the above findings will be further explored in the next chapter.

Chapter Eight

The Interpretation of the Research Findings and Conclusion

This chapter considers possible explanations of the empirical findings derived from the study. A theoretical framework is generated from the interview data and literature review to help interpret the statistical findings. To conclude, the chapter summarises the contribution of this study, and indicate the implications that emerge for policies pertinent to both staff research and effectiveness of doctoral education.

8.1 Interpretation of the Research Findings

The empirical findings between staff research and effectiveness of doctoral education on the whole corroborate the model of a neutral relationship between research and teaching in universities. The neutral relationships are especially reflected in the three aspects of supervisory effectiveness – supervisor's facilitation of learning, supervisor's accessibility and relevance of supervisor's research to student's. These findings reinforce the findings of Feldman (1987), Volkwein and Carbone (1994), Hattie and Marsh (1996), Braxton (1996), Melland (1996), Noser et al. (1996), Gottlieb and Keith (1997), Patrick and Stanley (1998) albeit that all of these focus on the relationship at the undergraduate level.

At the individual level, there is little evidence of a significant relationship between the RAE and the three aspects of supervisory effectiveness. It demonstrates that research performance as measured by the RAE ranking and supervisor's facilitation of learning, supervisor's accessibility and relevance of supervisor's research to student's as perceived by students are mutually exclusive, meaning that the RAE and the three aspects of supervision are likely to be independent activities. It is interesting to note that the disciplinary variations in the three aspects of supervision. Supervisor's facilitation of learning and relevance of supervisor's research to student's are more favourably perceived in Chemistry, whereas supervisor's accessibility is more favourably perceived in Education.

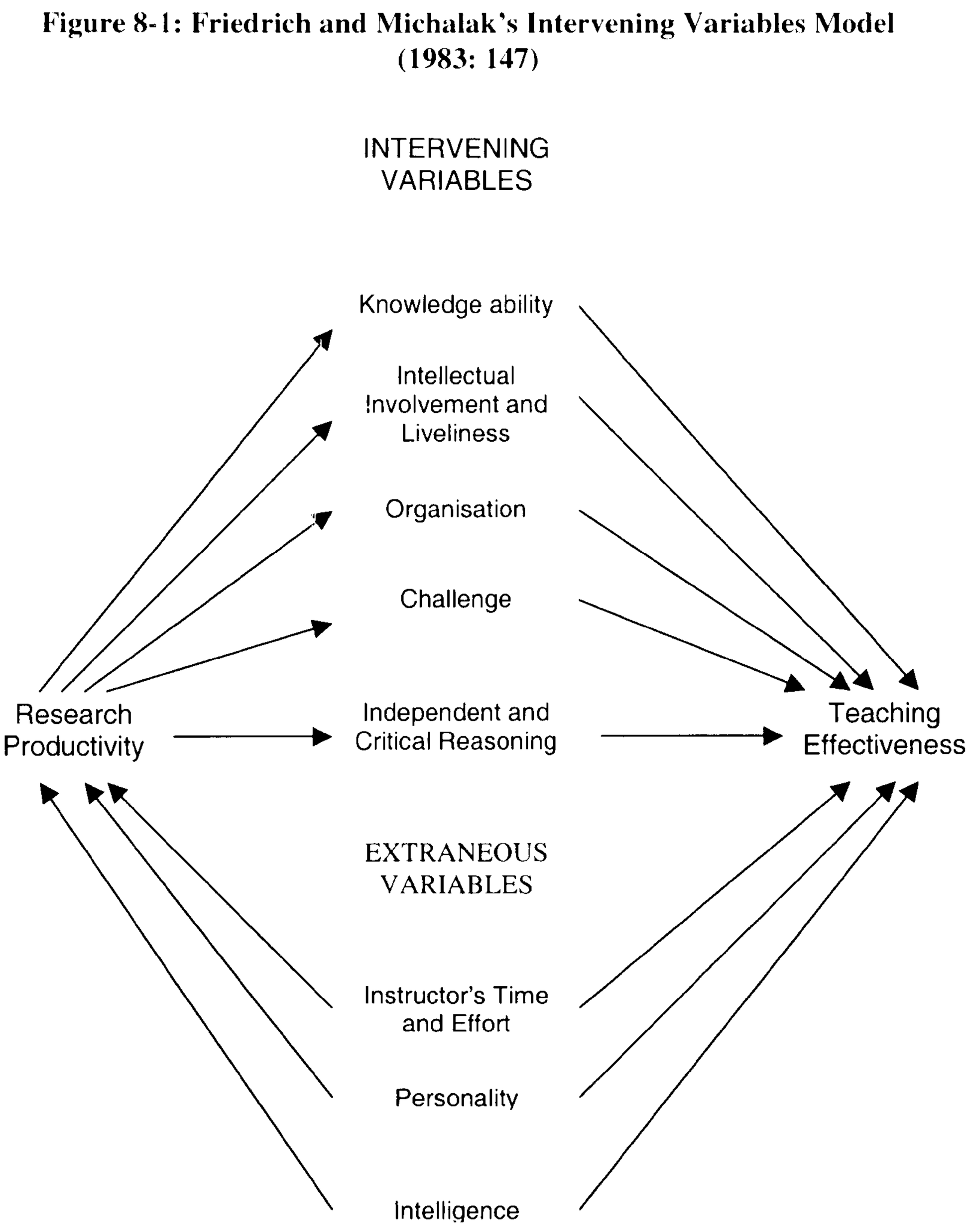
At the aggregate level, the results are more complex. It is found that doctoral education in Chemistry departments is more appreciated than in Education departments. This is seen in particular, with regard to academic culture of social interaction, intercultural facilitation of research and research facilities in effective research environment for doctoral students. Education departments are perceived as providing a slightly better research training programmes.

It is also found that the RAE ranking contributes little to the overall variance of the four aspects of research environment for doctoral students. This is especially reflected in Intercultural facilitation of research, where the RAE is found to have no bearing in either subject. On the other hand, the RAE is slightly negatively related to academic culture of social interaction in Chemistry, but not in Education. It has a slight positive relationship with research training programmes in Chemistry, but not in Education. Finally, the RAE is negatively related to research facilities in Education, but they are positively related in Chemistry.

Before making any interpretations, it is important to know whether the neutral relationships mean that staff research and teaching in doctoral education are mutually exclusive or that there are positive and negative forces counterbalancing one another. For example, perhaps staff research does have fairly strong positive effects on Supervisor's facilitation of learning, but they are somehow balanced by factors creating a negative relationship between the two. On the other hand, perhaps staff research does have a negative relationship with, for example, supervisor's accessibility, but they are somewhat offset by factors creating a positive relationship between the two.

To understand what might be underlying the neutral relationships between staff research productivity and general teaching effectiveness, Friedrich and Michalak (1983) propose a conceptual model. (Figure 8-1)

Figure 8-1: Friedrich and Michalak's Intervening Variables Model (1983: 147)



Friedrich and Michalak (ibid.) claim that little or no relationships between research and teaching can be influenced by "extraneous variables", such as personality factors. They argue that it is important to take account of the intervening variables to explain the relationship.

> The strength and direction of the relationship between teaching and research depend on the strength and direction of the relationships between research and each intervening variable, on the one hand, and of

> the relationships between each intervening variable and teaching, on the other.
>
> (Friedrich & Michalak, 1983: 147)

Friedrich and Michalak (ibid.) point out that the extraneous variables (instructor's time, personality, intelligence) can influence both research and teaching. If, for example, personality is positively related to teaching and negatively related to research, it will contribute negatively to the relationship between them. In other words, "if there were no relationship between research and teaching in the first place, an extraneous factor could create either a positive or a negative relationship (the so-called spurious relationship). If there were a relationship between research and teaching, an extraneous factor could – depending on the direction of its relationships with research and teaching – either strengthen that relationship (what might be called an enhancing effect) or weaken it (a suppressing effect)." (ibid.: 148-149)

They also find that other intervening variables (knowledge ability, intellectual involvement, organisation, challenge) can affect strength and direction of the relationship. For example, the stronger the influence of research on knowledge ability and the stronger the influence of that on teaching, the greater will be the contribution of that developmental sequence to the relationship between research and teaching. Also, for example, if the direction between research and intellectual involvement is positive and the direction between intellectual involvement and teaching is negative, then, according to Friedrich and Michalak, the overall contribution will be negative.

In the light of Friedrich and Michalak's model, the neutral relationships found in this study especially between staff research and supervisor's facilitation of learning, supervisor's accessibility, relevance of supervisor's research to student's can be caused by the "extraneous variables". The question then becomes: how much effect can those mediating extraneous factors (staff time and efforts, personality and intelligence) have on staff research on one hand, and on supervisor's facilitation of learning, supervisor's accessibility and relevance of supervisor's research to student's, on the other? According to Feldman, those mediating factors can be relatively weak in strength. (1987: 277) By themselves, they would produce either small positive or small negative correlation between research productivity and teaching effectiveness. In other words, it is important to recognise the mediating factors as proposed by

Fiedrich and Michalak on the three aspects of supervision bearing in mind that their effects can be uncertain.

On the other hand, these findings can be interpreted from the viewpoint of research training structure, which is illustrated by both the interview data and literature. It is proposed that the fundamental research training structure in the two subjects and its transformations can help understand the lack of an evident relationship between the RAE and supervisory effectiveness and effective research environment for doctoral students, and the disciplinary diversity in effectiveness of doctoral education. The following sections will explicate firstly the idea of fundamental research training structures of Education and Chemistry; secondly its possible transformations and finally the light they throw on the above research findings.

8.1.1 Fundamental Research Training Structures in Education and Chemistry

By 'fundamental research training structure', I mean the research training structures regarding the interaction among doctoral students, supervisors and their research projects in each discipline. From the interview data, two major research training structures are identified – a "Teamwork" structure and an "Individualist" structure.

The 'Teamwork research training structure' is found in Chemistry. It is a structure where doctoral students and their supervisors work on the same research projects. For example, in the interview data, G in Chemistry states that "You have to [work as a team]. That is the definition of a research group. The research group will fall apart if there wasn't a team. Without a team, this type of structure just wouldn't work." (G: section 7.2.1.1) Becher et al. (1994: 80) also note that "in the natural sciences, research was overwhelmingly undertaken in research teams and there were strong links between disciplinary norms and the organisation of research." It normally applies to scientific subjects, where students' thesis topics are given by the supervisor. (Becher, 1994) In Chemistry for example, research "tends to involve teams comprising tenured staff, post-doctoral staff, doctoral students and technicians, and is of course heavily dependent on laboratory apparatus and accommodation." (ibid.) The spirit of teamwork, therefore, is accentuated.

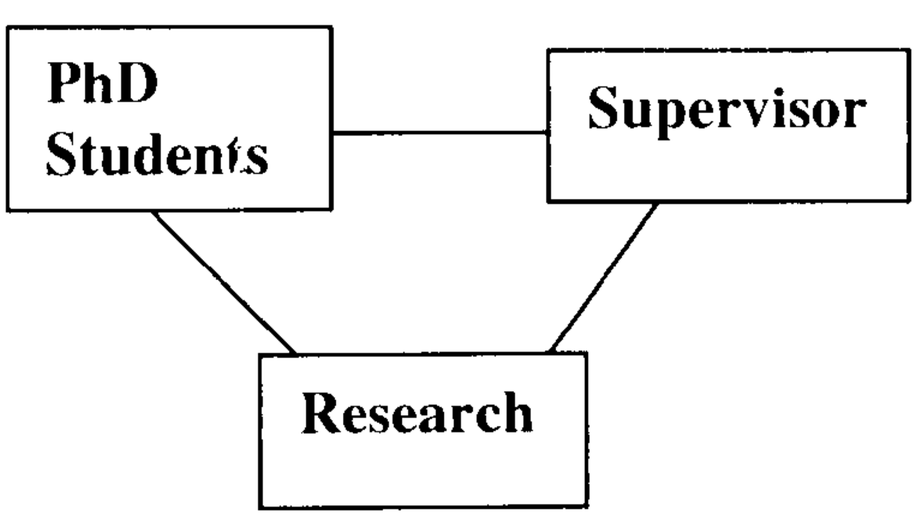
The findings (discussed in section 5.1) that Chemistry as one of the hard, pure, non-life (Biglan, 1973a, 1973b), high-paradigm (Lodahl & Gordon, 1972) and scientific (Snow, 1959) subjects can also contribute to the teamwork nature of research training structure. Chemistry with cumulative knowledge (Becher, 1984, 1987a, 1987b) needs great collaboration (Becher, ibid.) to develop itself. The emphasis of collaboration together with a convergent way of thinking (Hudson, 1966) and its tendency to attract assimilators who shine at inductive reasoning (Kolb, 1981) help form the solidarity of a research group.

The second fundamental research training structure, I call the 'Individualist research training structure', is found in Education. By 'Individualist research training structure', I mean a structure where doctoral students and their supervisors work on different individual research projects. For example, A states, "He [A's supervisor] has his own research which is not the same as mine. He doesn't look at higher education. He doesn't look at the process of socialisation and profession. In that way, his work is very different from my work, although he helps me with mine." (section 7.2.1.1) "The typical pattern in the social sciences and humanities is for academics to carry out individual research which is separate from that of their students." (Becher et al.,1994: 82) In other words, PhD students can make their own choices about their thesis topics. (Becher, op. cit.) Due to this, "within economics, sociology, modern languages and history the dominant conception of research is as an individual pursuit." (Becher et al., op. cit.: 80) The idea of individualism, therefore, is promoted.

The earlier findings that Education as one of the soft, applied, life (Biglan, op. cit.), low-paradigm (Lodahl & Gordon, op. cit.) and artistic (Snow, op. cit.) subjects help understand the individualist nature of research training structure. Education with functional knowledge (Becher, op. cit.) calls for a divergent way of thinking (Hudson, op. cit.) to progress itself. Their way of communication is individualised. (Becher, op. cit.) The promotion of divergence (Hudson, op. cit.) and the tendency to attract accommodators who excel in the ability to carry out projects in the new conditions (Kolb, op. cit.) reinforce the individualistic character of the research training in

Education. These two different structures of research network and their features are presented in Figure 8-2.

Figure 8-2: Comparison between Research Training Structures of Teamwork and Individualism



Teamwork
(Chemistry)

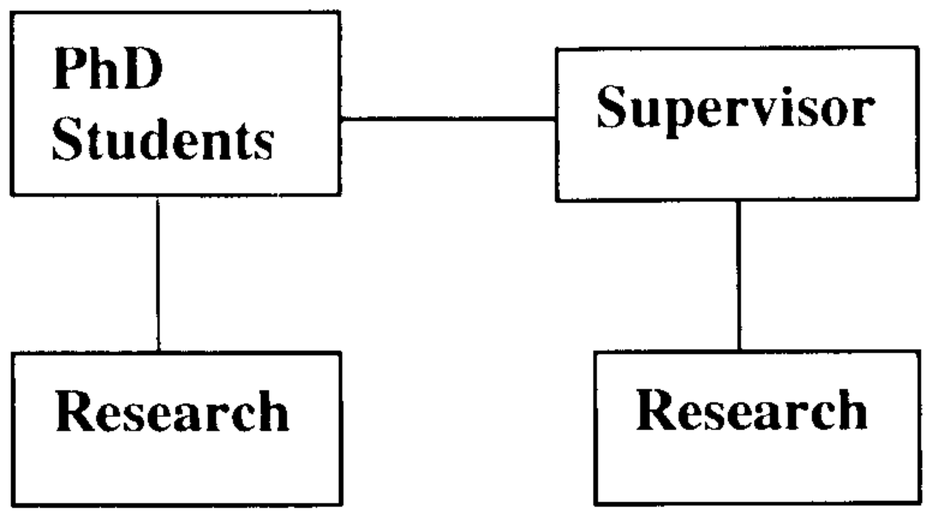
Working level:
PhD students and their supervisors work at the same projects at the same level.

Role of supervisor:
Adviser also a working colleague.

Role of PhD students:
Regarded as junior but full members of the group.

Way of interaction:
Sense of collegiality; frequent contact, casual, not hierarchical.

Resources:
Shared resources; relatively easy for students to access funding and facilities e.g. computers and research instruments.



Individualism
(Education)

Working level:
PhD students and their supervisors work on different projects.

Role of supervisor:
Adviser or a consultant.

Role of PhD students:
Regarded as learners and not as full members of the group.

Way of interaction:
Sense of distance; infrequent contact, formal, hierarchical.

Resources:
Limited student access to funding and facilities.

(source: compiled by the author from the materials discussed in the text.)

The Teamwork and Individualist research training structures have a great influence on the individual relationships between supervisors and doctoral students, and the research environment for doctoral students at the departmental level. They also have a great impact on doctoral students' research process and learning experiences. To

begin with, in the Teamwork research training structure, the interactions between doctoral students and their supervisors are frequent and informal. (section 7.2.1.3) Heath (2002) also finds that "in practice, science candidates working in laboratories often have incidental meetings with supervisors, and can solve many problems informally without having to wait for a formal meeting." (ibid.: 50) Their relationship is more like a traditional apprenticeship. Doctoral students usually meet their supervisors on a daily basis. (section 7.2.1.3) Apart from the normal teacher-learner relationship, they are also more like working colleagues. (section 7.2.1.2) There are many opportunities for research students to observe and get immediate advice from supervisors and other members of the group, such as post-doctoral students, research fellows and other academic staff. (section 7.2.1.2 & 7.2.2.3; Becher et al., 1994; Heath, op. cit.: 50) The role of supervisor, therefore, is seen not only as an advisor but also supplemented with a sense of partnership or collegiality (section 7.2.1.2). Due to the emphasis on teamwork, close interaction and a sense of collegiality, the overall atmosphere in the department appears to be casual, friendly and lively. Many research resources and facilities are shared between supervisors and their doctoral students. Doctoral students are more likely to be valued and be treated as full members of the research group. (section 7.2.2.2; Becher et al., ibid.)

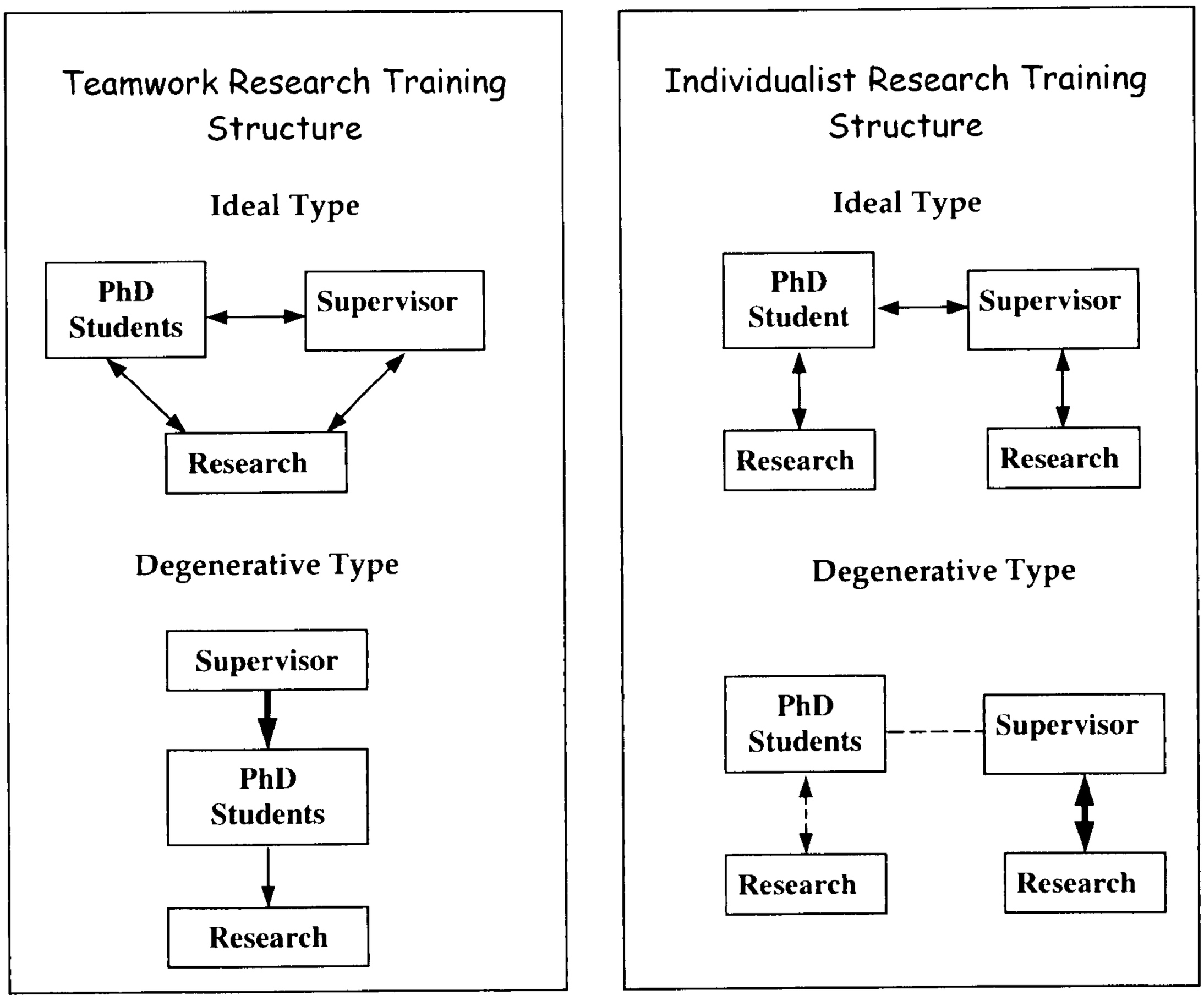
On the other hand, the interaction between doctoral students and their supervisors in the Individualist research training structure is less frequent and more formal. In most cases, doctoral students need to make formal appointments in order to meet their supervisors. The meetings could be once every two weeks or once a month (section 7.2.1.3). The rest of the time, students work on their own projects by themselves. Compared with the laboratory in science, the library plays an important role for students in humanities. (Becher et al., ibid.) While the laboratory provides a place for social and interactive activities for Chemistry students, the library is for individual readings of Education students. The relationship between doctoral students and supervisors hardly goes beyond typical teacher-learner interaction. Supervisors are seen to be advisers, or consultants in some cases. The departmental atmosphere derived from this kind of research training structure is a sense of distance, formality, classification, or sometimes hierarchy, between staff and doctoral students. (section 7.2.2.1 & 7.2.2.2) Doctoral students in this structure are less likely to be recognised as full members of the group. (section 7.2.2.2) Research resources and facilities are

less likely to be shared between staff and doctoral students. The differences between these two research training structures will be addressed in detail later.

8.1.2 Transformations of Fundamental Research Training Structures

Furthermore, what happens in the research training structures is not fixed. I suggest that both research training structures have their 'Ideal' type and 'Degenerative' type. By 'Ideal type', I mean that all the given conditions are working well. This suggests that both human and physical resources are adequate and well distributed; competition is constructive and no pressure on staff to publish. By 'Degenerative type', I mean that the ideal conditions are not met. The two research training structures in these two types are presented in Figure 8-3.

Figure 8-3: Relationships of Research Training Structures in Two Types



(source: compiled by the author from the materials discussed in the text.)

When the given conditions are working well, the Ideal type of the Teamwork research training structure would function in an environment where the co-operation between researchers is promoted at all levels. This cultivates doctoral students to be co-operative researchers with good interpersonal skills. On the other hand, in the Ideal type of the Individualist research training structure, PhD students would be able to call upon supervisors and other researchers whenever it is necessary. This encourages the sense of autonomy and liberty, leading to the education of independent thinkers.

The Degenerative type means that the above conditions are not met. This may happen when either human or physical resources are inadequate and especially when the competition is destructively intense, such as the great pressure for publication. There may be a shortage of staff and resources, leading to highly competitive application for funding, severe competition for reputation and heavy pressure of publishing for academic staff.

Under those extremely pressurised conditions, the Teamwork research structure could result in a more self-centred approach by supervisors taking over the research projects carried out by doctoral students. For example, students become "hands of their supervisors" to do "dirty jobs" in the laboratory. (section 7.2.1.2 & 7.2.2.2) In one of the interview sites, students are asked to sign a contract that "they [students] can only have one Sunday free in a month and they do not even have bank holidays." (section 7.2.1.2) The highly competitive situation for "team's productivity" is likely to have detrimental effect on doctoral students. (Becher et al., 1994) As a consequence, either the research projects are likely to be taken over by the supervisors or a large number of PhD students are recruited to do "dirty jobs" for staff. In the latter case, it was regarded as "a strategy for maintaining the team leader's own rate of publication ... in a context where most of his time is spent essentially on team management." (quoted in Becher et al., ibid.: 72) This strategy may pressurise students to "prolong the experimental stages of their work or neglect of them on the part of their supervisor." (ibid.) Doctoral students then are treated as cheap labour. (Brown & Atkins, 1988: 117) For example, informant H who has a Graduate teaching studentship states, "so the only benefit for the college is that they get a member of staff for four years who does all the bad bits of teaching and you only have to pay them nine thousand pounds

a year. Whereas if you get a junior lecturer, you have to pay much more. In that sense, yes, I think it is cheap labour. ... Yes, PhD students are very cheap, very good value for money for the research. If you want to research for academics, it's very cheap to have a PhD student and not very cheap to have a postdoc" (section 7.2.2.2) Both doctoral students' efforts and creativity are prone to be exploited by the supervisor. The work of the individual student is sacrificed to the research group and the department as a whole. (section 7.2.1.2)

In contrast to the cultivation of constructive team co-operation in students in the Ideal type of the Teamwork research training structure, students in the Degenerative type of departments may suffer from academic procrastination or dilatoriness (Boice, 1996: 31; Ferrari et al., 1995: 80-81) and self-handicapping syndrome (Boice, op. cit.; Ferrari et al., op. cit.). These can be caused by imposing instructions from the supervisors, which perhaps leads to subordinating behaviour and task aversiveness for students (Muszynski & Akamatsu, 1991 in Johnson et al., 2000a: 270). Academic procrastination refers to (1) "lack of promptness, either in intention or in behaviour"; (2) "intention-behaviour discrepancy" and (3) "preference for competing activities". (Ferrari et al., op. cit.: 72) Self-handicapping behaviour means people "who handicap themselves by spending less than adequate time on projects likely to succeed than on projects likely to fail." (Boice, op. cit.: 31) Although laboratory sciences students have the lowest rate of attrition compared to students in the social sciences and humanities (Bair & Haworth, 1999: 10), academic procrastination and self-handicapping syndrome can increase the time to completion of the degree and also develop students' impaired self-understanding (Boice, op. cit.: 32). As a result, students may lack academic confidence in their research area.

In the Individualist research training structure, the poor and highly pressurised conditions can distract either academics from their supervision of students or the departments to provide good research education for students. According to Becher (1987a: 286; 1989: 86), the pressure to publish in soft-applied subjects such as Education is generally less than hard-pure subjects such as Chemistry. (section 5.1.2) Nevertheless, the severe competition caused by the RAE may have brought more pressure to bear on academics, which in turn has degenerative effect on the doctoral education. Under those conditions, academics focus more on their own research

projects (Becher et al., 1994); doctoral students are likely to suffer from the neglect both from the supervisors (section 7.2.1.2) and the department (section 7.2.2.1 & 7.2.2.2). For example, B finds that supervisors are seen to be passive and "un-interested" in relation to students' research. (section 7.2.1.2) D reasons that the neglect of Education doctoral students' research at the department level is because doctoral students' research is not considered in the RAE evaluation. "I think until you can contribute to that RAE score, you are not important. You may well attend the conference, you may even write the paper, but it has not got the same ... it doesn't count for anything. Until the moment you can be included into their score, then it has some relevance." (D: section 7.2.2.2) Education students' research may not be interfered with by the supervisors' as those in the Teamwork research structure are. Instead, they are prone to feel they are being left to sink or swim.

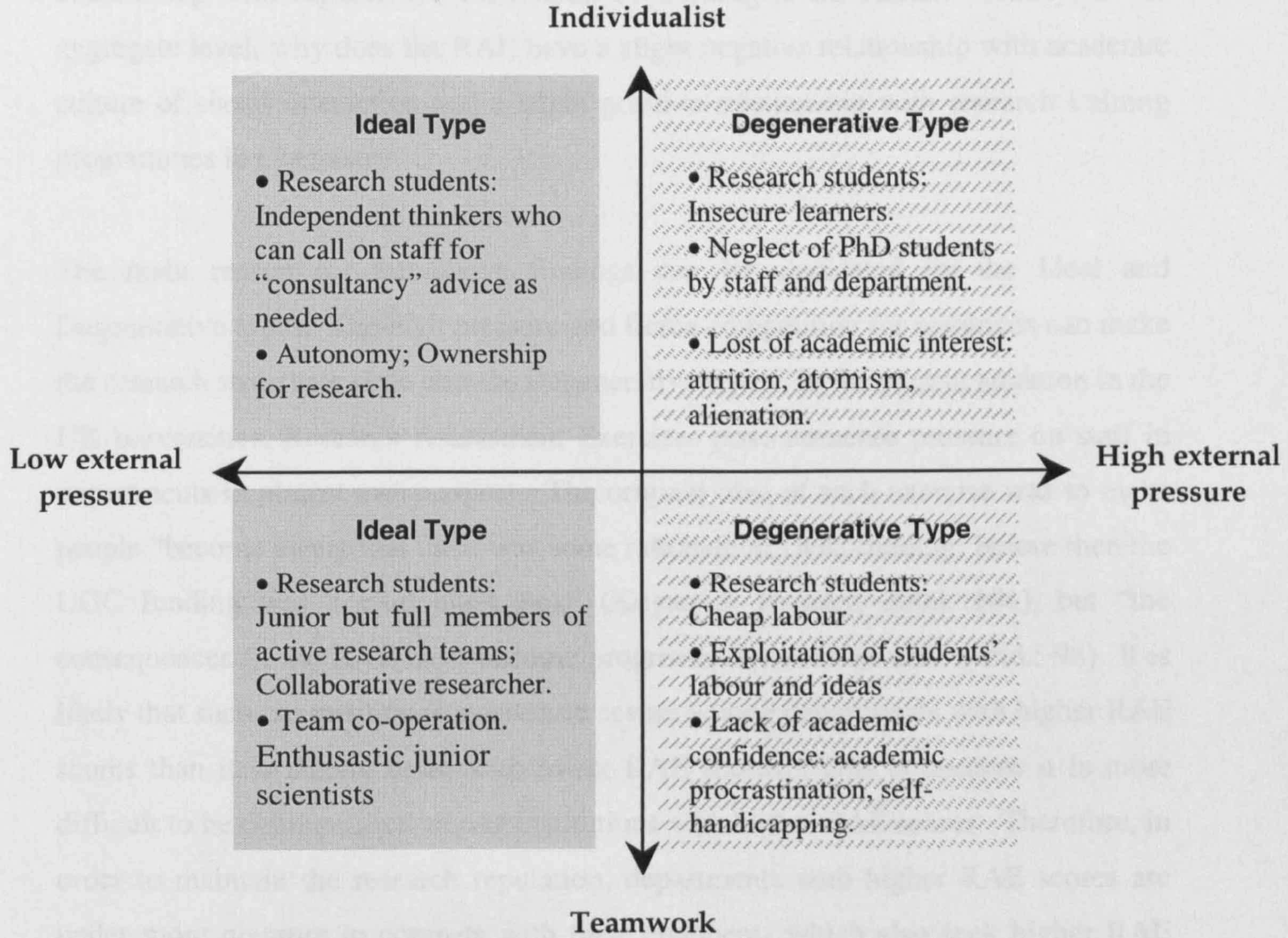
In comparison with the encouragement of autonomy and ownership for research in students in the Ideal type of the Individualist research training structure, students in the Degenerative type of departments are prone to suffer from attrition (Bair & Haworth, op. cit.). The difficult accessibility of supervisors resulting in lack of guidance in the Degenerative type of departments, and the individualistic nature of student research in general can bring about students' feelings of isolation (Lovitts, 1996), deprivation and alienation (Golde, 1994). It can also cause "atomism" and "pluralistic ignorance" among students (Lovitts, op. cit.). As a consequence, it not only can result in academic procrastination leading to serious delay and high attrition. It also can make students lose their academic interests in their research areas, which can lead to giving up a research career and finding jobs outside the academy (Kendall, 2002: 133; Harman, 2002: 184-186) even if they finally complete their PhD.

Becher, Henkel and Kogan (1994, op. cit.) point out that unsatisfactory experiences of postgraduate students are likely to exist in most prestigious institutions or in the context of intensive competition among academics. (see section 2.4) The high pressure conditions in Degenerative types of both research training structures can also jeopardise the wide range of different roles which should be undertaken by the supervisor (Bennett & Knibbs, 1986; Phillips & Pugh, 1987; Brown & Atkins, 1988; see section 4.3).

8.1.3 Theoretical Framework of Fundamental Research Training Structures and Its Illumination on the Research Findings

The combination of these two types and two research structures are presented in a two dimensional frame. Figure 8-4 presents the corresponding features of the four combinations.

Figure 8-4: Features of the Research Training Structures in Two Types



(source: compiled by the author from the materials discussed in the text.)

This theoretical framework horizontally differentiates the Ideal and Degenerative types by the degree of external pressure. Vertically it distinguishes the Individualist and Teamwork structures.

To begin with the framework horizontally, it helps throw some light on the major finding: why is there little evidence of a strong and significant relationship between staff research and effectiveness of doctoral education, especially concerning the three aspects of supervision, which applies to both subjects? In particular, at the individual level, why does the RAE have in general a neutral relationship, in both subjects, with supervisor's facilitation of learning, supervisor's accessibility, relevance of supervisor's research to student's in supervision, and with intercultural facilitation of research in research environment for doctoral students? Having said this, why do the empirical findings tentatively suggest that the RAE may have a slight negative relationship with supervisor's accessibility in Chemistry, and a slight negative relationship with supervisor's facilitation of learning in Education? Finally, at the aggregate level, why does the RAE have a slight negative relationship with academic culture of social interaction and a slight positive relationship with research training programmes in Chemistry?

The main reason for the above findings can be elucidated by the Ideal and Degenerative types. The high pressure and fierce competition for resources can make the research structures slide into the Degenerative types. In the current situation in the UK universities, Research Assessment Exercises pose immense pressure on staff in departments in almost every aspect. The original idea of such exercise was to make people "become aware that there was some rationale in UGC funding; before then the UGC funding was a total black box" (Kogan & Hanney, 2000: 101), but "the consequences of the RAE have become progressively more severe." (ibid.: 98) It is likely that such competition is even more severe among departments with higher RAE scores than it is among those with lower RAE scores. This is because it is more difficult to be distinguished among institutions with higher RAE scores. Therefore, in order to maintain the research reputation, departments with higher RAE scores are under more pressure to compete with their opponents which also seek higher RAE scores. For example, in eight research-intensive universities in Australia, Harman found that "the [PhD] student satisfaction levels are disturbingly low" (2002: 188).

Under these circumstances, Chemistry departments with high RAE scores are likely to be at the very right end of the horizontal axis -- becoming a serious case of the Degenerative type in the Teamwork research training structure, while Chemistry

departments with low RAE scores are more likely to be relatively nearer to the Ideal type. This means, Chemistry students in the departments with high RAE scores are prone to be negatively exploited.

It could be because departments with high RAE scores slide further towards the far right end of the Degenerative type so that Chemistry doctoral education, especially in all three aspects of supervision and in intercultural facilitation of research in research environment for doctoral students, do not become better in departments with higher RAE ranking. It is perhaps because the Degenerative type of the Teamwork structure in the departments with higher RAE scores makes academic staff and students difficult to relate to each other so that academic culture of social interaction in Chemistry is seen to be less satisfactory. Similarly, it is due to the same highly pressurised conditions in the Chemistry departments with higher RAE scores that supervisors become less accessible for students. The reason for a slight positive relationship between the RAE and research training programmes could be because formalised research training programmes are a new practice in Chemistry doctoral education. When the questionnaire survey was conducted, less than half (48.3%) of Chemistry departments have some form of research training programmes. The departments which have formalised research training programmes tend to be concentrated in those with high RAE scores.

In a similar vein, the competition among Education departments with high RAE scores is likely to be much fiercer than it is among those with low RAE scores. The pressure of publication on each member of staff in the Education departments with high RAE scores is greater than in those with low RAE scores. For this reason, Education departments with high RAE scores are likely to be at the right end of the horizontal axis where the serious cases of the Degenerative type of the Individualist research training structure are located. Education PhD students in those departments, therefore, are likely to experience neglect from both the supervisor and the department. They feel left alone and struggle on their own.

As a consequence, it could be because of the Degenerative type of the Individualist research training structure in the Education departments with high RAE scores that staff are too busy with their own research to be available for doctoral students. This

explains why supervisor's accessibility is not perceived to be better in Education departments with higher RAE scores. The highly competitive conditions can make Education departments with higher RAE scores too preoccupied with promoting staff research to merit attention to doctoral students' research and education, that academic culture of social interaction and research training programmes are not perceived to be better. The same stressful conditions in Education departments with higher RAE scores may further frustrate the communication between supervisors and students, that students are less made aware of supervisor's research. This explains why there is no relationship between the RAE scores and relevance of supervisor's research to student's research. Next, due to the Degenerative type of the Individualist research training, Education departments with higher RAE scores are so concerned with staff research and publication that doctoral education could be marginalized. As a result, those departments may neglect of PhD students, especially those come from foreign countries, so that intercultural facilitation of research is tentatively suggested to be slightly less satisfactory in the departments with higher RAE scores. In addition, for the same reason of the Degenerative type, academic staff in the departments with high RAE scores could be unavailable for students. Therefore, supervisor's facilitation of learning is tentatively implied to be slightly less satisfactory in the department with higher RAE scores.

On the other hand, the vertical dimension of the theoretical framework helps explain not only the disciplinary variations in some of the relationships between staff research and different aspects of doctoral education but also the disciplinary differences in effectiveness of doctoral education. That is, why the RAE score is positively related to research facilities in Chemistry, but in contrast it is negatively related in Education? Why do the empirical findings with regard to supervision tentatively suggest that the RAE may be slightly positively related to relevance of supervisor's research to student's in Chemistry, but not in Education? Why is Chemistry doctoral education in general seen to be more appreciated than doctoral education in Education especially concerning research environment for doctoral students?

In the Teamwork research training structure, doctoral students are more likely to have a sense of their worth. Owing to the nature of teamwork, their work, efforts and research contribution tend to be recognised by the group or department. For example,

none of the Chemistry informants feel that their research is neglected because doctoral students are the backbone of the academic community – they are those who actually carry out Chemistry research in the department. "Definitely not [neglected], because, as I described they [the staff] really rely on PhD students' work, man power, labour. If it wasn't for them, it wouldn't have any research." (H: section 7.2.2.2) "Because this [PhD students' research] is the basis for the departmental and group research." (G: section 7.2.2.2) This is echoed by the remarks from scientific informants in the research of Becher, Henkel and Kogan (1994). It shows how the students' contribution to scientific knowledge has been recognised:

> "students contribute massively to knowledge ... without graduate students [my] reputation would be considerably lower".
> "within the UK tradition the bulk of research [in biochemistry] is done with graduate students and postdoctoral students".
> "without our gradate students we should die".
>
> (Becher et al., 1994: 73)

By being full members of the research community, the easy access to resources and facilities in the group tend to make research students feel supported. The close, casual and co-operative human interaction, leading to a friendly research environment for doctoral students, reduce their sense of isolation, separation or loneliness during their doctoral studies. (section 7.2.2.3)

Moreover, the sense of collegiality or partnership as discussed earlier also helps develop their confidence in being cooperative and mature researchers. For example, "By the second and third year, they [students] have got more background information and they are basically the experts in the field in the department." (G: section 7.2.2.2) Take another example in the study of Becher et al. (1994) in Physics and Biochemistry:

> The most important group for the students – as for their more senior colleagues – is the research group, not the university departments. The size of the group might vary – anything from six to 300 – but even for those engaged in theoretical research it is exceptional for students to work alone.
>
> (Becher et al., 1994: 71)

The resulting consequences are that firstly, the Teamwork structure leads to the sharing of resources in Chemistry such that research facilities for students are perceived to be better in the department with higher RAE scores. The lack of this

teamwork dynamics in Education in general can lead to the absence of resource shared between staff and students. The lack of sharing resources plus the Degenerative type found in the departments with high RAE scores further explain why research facilities are perceived to be less satisfactory in Education departments with higher RAE scores. Next, it is recognised in the Teamwork research training structure that in order to have the utmost result of contribution and publication in a high paradigm area (Lodahl & Gordon, op. cit.), supervisors and students need to be co-operative (Becher, 1984, 1987a, 1987b, 1989; Becher & Trowler, 2001) and their research need to be closely linked. It could be because of this reason that supervisor's research is more related to that of student's in Chemistry than in Education. It is perhaps due to the Teamwork research training structure in Chemistry, leading to sharing, co-operation, collegiality, informality, sense of worth and friendliness, that Chemistry departments are more appreciated than Education departments especially pertaining to most aspects of research environment for doctoral students.

In contrast to the Teamwork structure, doctoral students in the Individualist research training structure are seen to have tougher experiences. Due to the individualist nature of this research training structure, doctoral students are likely to develop a sense of independence. It encourages students to become independent scholars or researchers. (Becher et al., ibid.) They may have autonomy in the process of doing their own research and a strong sense of ownership of their thesis, but they may not feel as greatly valued as students in the Teamwork research training structure during their studies. First of all, they are not recognised as full members of the group. For example, three informants in Education think that doctoral students are not treated as full members of the research community. (A, B & D) D puts it:

> You didn't necessarily bump into other members of the research group at the free time. You have to make the appointments to go and see either your own supervisor. You are never *part* of that department. You never got involved in sort of more ... I mean, it doesn't mean to say you won't ask to come in or you couldn't be in the department, but I'm always a bit of an outsider.
>
> (D: section 7.2.2.2)

Becher et al. (1994) find that there is no comparable mechanism for incorporating research students in a research team in social sciences such as sociology and economics as found in sciences. Their research reveals that:

> This is a convention in which the interests of the academic and the student do not necessarily coincide, and the notion that they are engaged in a shared responsibility for advancing knowledge may be true only in a general sense.
>
> (Becher et al., 1994: 82)

For this reason, doctoral students' research efforts and contribution to knowledge are less recognised by the group or department in the Individualist research training structure than in the Teamwork structure. For example, all the informants in Education think that doctoral students' research is neglected to different degrees by the departments. "I know that there are two others, one professor and one doctor, who know about my research quite well. But then *I doubt* if many of the others know ... So it's neglected in that way – in the general awareness, I imagine, what PhD students are doing." (A: section 7.2.2.2) A similar view is also shared by B who thinks that students are only known as "research students" and not as individual persons. (ibid.)

Furthermore, the more difficult access to resources and facilities in the Individualist research training structure is likely to make doctoral students feel less supported in the research environment. This feeling of lack of support plus the remote and formal human interaction with their supervisors and in the department increase their sense of isolation, indifference and probably loneliness. For example, none of the Education informants think that it is easy to have informal interaction with staff in the department. (section 7.2.2.3) "Virtually not at all." (D: ibid.) Even if there are social events for both staff and students to attend, "It is very much depending on *we* pushing ourselves to interact with them." (B: ibid.) Generally speaking, the Individualist structure accompanied with the weak sense of partnership, and strong sense of distance and hierarchy in the departments (section 7.2.2.3) contribute to the informants' feelings of isolation, separation and loneliness. All of them think that doctoral study is a very isolated, separated and lonely process. (ibid.) For example,

> It's not only the physical reasons that we talked about but also the fact that where I am we have very individual pieces of research. That's another isolating factor. I think at the end of day, doing a PhD is very isolating. For me, there is no community. Physical distance, the fact that everyone is pursuing individually a very particular piece of research: there is no community of research; there is no joint research, no department research. Those are quite isolating factors. And therefore I think for me it has been a very isolating, very lonely kind of existence. Can I use a metaphor? It's a bit like being in a boat paddling yourself.

> There is no one else in the boat with you. You kind of paddle along on your own.
>
> (D: section 7.2.2.3)

If this speculation is right, it could be a further reason why doctoral education in Education is seen to be less satisfactory than in Chemistry especially concerning research environment for doctoral students. From the viewpoint of research training structure, the Teamwork structure means that Chemistry students are likely to feel supported, valued and less isolated. In contrast, an Individualist research training structure suggests that Education students are likely to feel unsupported, not recognised, isolated and remote. Few resources are shared between Education staff and students. Therefore, not surprisingly Chemistry students are seen to enjoy their doctoral education more than Education students. Furthermore, when high pressure conditions are present in Education, the situation degenerates more in the departments with higher RAE scores. Therefore, it is not difficult to understand why supervisor's facilitation of learning in Education is perceived to be slightly less satisfactory in the departments with higher RAE scores.

The Individualist and Teamwork research training structures can also explain why the response rate of Education students (81.3%) is much higher than Chemistry students (41.3%). One obvious reason is that Chemistry students are less familiar with the questionnaire survey than Education students so they are less interested in replying them. However, the reason underlying this finding can be because Education students working in an Individualist research structure are more likely to feel less heard and feel less appreciated than Chemistry students (Moser & Kalton, 1975: 262; Aldridge & Levine, 2001: 18). Therefore, there are more responses from Education than Chemistry students when Education students have an opportunity to address their opinions and feel valued.

In conclusion, however, it must be stressed that so far this framework of research structures remains largely a theoretical inference, which needs more evidence and further investigation.

8.2 Conclusion

Strong opinions about the connection between research and teaching are not difficult to find. Many previous writers suggesting the complementary relationship model were quite certain that research and teaching enhance each other and therefore, the best researcher is the best teacher; the department with best research performance provides the best education for students. In direct response to this contention, writers in the competitive relationship model, with equal certainty, proclaimed that research and teaching are constantly in conflict with each other. At the individual level, "the more research a professor has done, the more books and articles he has written, the better teacher he is supposed to be. But the opposite is more likely to be the case." (Cutten, 1958 quoted in Feldman, 1987: 275) At the aggregate level, departments with high research performance are too busy promoting staff research to pay attention to students' learning.

However, findings of extant research reviewed in Chapter Three are inconclusive. Although some of the empirical studies took into account disciplinary variations and the perspective of students, the majority of them only focused on undergraduate education. Little research has been carried out in doctoral education. The present study which aims to investigate research/teaching relationships at the doctoral level finds that, on the whole, there is little evidence for a significant relationship between staff research and effectiveness of doctoral education. In other words, the Neutral relationship model is endorsed, especially pertaining to all three aspects of supervision (supervisor's facilitation of learning, supervisor's accessibility, relevance of supervisor's research to that of student's) and intercultural facilitation of learning in research environment for doctoral students. Disciplinary variations were also found in the above areas.

Obvious interpretations of the results of this study can be that in general, the likelihood that staff research productivity actually benefits or damages teaching in doctoral education is small, although there are some disciplinary variations. An important conclusion would be that staff research performance and teaching in doctoral education are independent activities. This can mean that low staff research productivity does not seem to greatly undermine effective supervision and effective

research environment for doctoral students. It is noteworthy that Chemistry departments are seen by their students to provide better doctoral education on most counts than Education departments.

Consequently before drawing any final conclusions, it is important to understand the possible reasons underlying the complexity of these findings. In the light of interview data and literature, a framework of research training structures is offered. It is proposed that on the whole, the lack of a relationship between staff research and doctoral education can be because of the high external pressure of competition and research publication put on staff and departments in the UK universities, which refers to as the 'Degenerative type'. The external pressure especially has a seriously degenerative effect on departments with high research performance where competition is fierce. The severe case of 'Degenerative type' then explains why departments with higher RAE scores are not seen to have significantly better doctoral education especially pertaining to three aspects of supervision and why they are perceived to be less satisfactory in many aspects of research environment for doctoral students.

It is also proposed that some of the disciplinary variations found in the research/teaching relationship and the disciplinary differences found in effectiveness of doctoral education can be caused by the distinct research training structures underlying Education and Chemistry. Education with an Individualist research training structure promotes the idea of independent thinkers. However, it can also entail isolation, separation, formality and difficulties in sharing resources between staff and students, which may lead to unfriendliness and exclusiveness. As a consequence, Education students tend to feel unsupported, unheard, unvalued and excluded from the community of the department. In contrast, Chemistry with a Teamwork research training structure promotes the idea of co-operation. It facilitates two-way communication, sharing resources, trust and informality, which contribute to friendliness and inclusiveness. As a result, Chemistry students tend to feel valued, not isolated, and recognised as full members of the community. Therefore, owing to the differences between the Individualist and Teamwork research training structures, doctoral education is perceived to be more satisfactory especially pertaining to aspects of research environments for doctoral students in Chemistry than in Education. It also

explains why research facilities have a positive relationship between the RAE ranking in Chemistry, because resources are widely shared between staff and students in the Teamwork research training structure. When Chemistry departments with higher RAE ranking receive more research funding, students in those departments can also share the richer research resources.

Following upon this discussion and the findings in the research, I may now put forward some ideas for future research and proposals for action. To begin with, the findings of this research pertaining to the relationship between research and teaching reveal a somewhat different picture from previous studies, especially those which focus on staff perspective and those which are only based on staff self-reported rating of either their own teaching or the link between research and teaching (Chapter Three). The result shows that there is a discrepancy between staff perceptions of their own teaching and students' experience of teaching. It also challenges those studies which do not measure research and teaching separately but are only based on staff's perceptions of the link between research and teaching. One of the important lessons from this research is that the findings about the relationship between research and teaching can be partial if only staff perceptions are taken into account. Hence, it is crucial to investigate the relationship between research and teaching from a student's perspective. Due to this, there exists a strong need for research that seeks to gain directly from doctoral students about their thoughts, experiences, feelings, behaviours and subsequent performance inside or outside their discipline regarding measurement of doctoral teaching (such as supervision and research training) and the link between research and doctoral education.

Furthermore, more than 40% of full-time doctoral students are from foreign countries according to HESA (2002) and the findings show that foreign students in general are less satisfied with the doctoral education than home students. As a consequence of this, more research would be needed to look at how the doctoral education corresponds to the cultural variations of students.

The discovery of lack of a relationship between staff research and teaching in doctoral education in general does not mean that staff research and teaching have the same status. In most cases, research (or the scholarship of research) is more valued in the

academic community than teaching (or the scholarship of teaching). (see discussion in Chapter Two and of the asymmetric nature of the relationship between them in Chapter Three) Consequently, scholarship of teaching will still need to be promoted if good quality doctoral education is to be delivered. At doctoral level, this includes the recognition of doctoral supervision. Doctoral education should be part of teaching assessments. Both individual supervisors and departments who are committed to good supervision should be rewarded.

In the light of the evidence, it may be claimed that the current mechanism of research assessment in the UK universities, the RAE, provides few benefits to doctoral education. Further investigation is needed, therefore, for finding a better way of evaluation of research and research training in order to promote both staff research and teaching in doctoral education.

The second area for new thinking is that of the disciplinary differences in doctoral education. It is clear that much research effort is needed in order to advance thinking and practice in doctoral education pertaining to the relationship with staff research. If staff research is generally not related to teaching in doctoral education, the important question for further investigation then becomes: what makes a good quality doctoral education and what does it mean in an Individualist research training structure such as Education and in a Teamwork structure such as Chemistry respectively? At the individual level, it faces issues such as, what factors constitute a good supervision in the two different research training structures? How to investigate the one-to-one supervision from inside and does it require different approaches in the Individualist and Teamwork structures? How to evaluate, facilitate, promote and reward supervision in Education and Chemistry respectively? At the aggregate level, it concerns: what is a good research environment for doctoral students in the Individualist and Teamwork research training structures? How to introduce and integrate doctoral students into local, national and international academic community in the different research training structures? How to assess a good research environment for doctoral students in the different disciplines? How can central and departmental systems concerning academic staff, resources, funding, reward, policy and assessment best support a good supervision and good research environment for

doctoral students bearing in mind the differences between the two research training structures?

If my interpretations of the results of disciplinary differences are along the right lines, they imply that supervisors and departments in Education will need to improve their recognition of the importance of doctoral students and increase the attention they pay to the well being of doctoral students more than their counterparts in Chemistry. In a practical sense, it would involve matters such as recognising Education doctoral students' contribution to knowledge, welcoming doctoral students as members of the community of scholars, valuing doctoral students' research, sharing resources and two-way communication. The recognition of doctoral students in Education not only promotes the quality of students' learning experiences but also can help to shorten the completion time of Education PhD programmes.

Further research will be called to explore questions such as, would research training in Education improve if it involves doctoral students in staff research projects as it does in Chemistry? How to facilitate doctoral study in Education to learn from the spirit of teamwork in Chemistry to improve the supervisor-student interaction and to solve the isolation experienced by doctoral students and marginalisation of doctoral education in Education? Would doctoral study in Chemistry improve if it learns from the spirit of individualism in Education to avoid interfering of student's ideas in doing research or treating students as cheap labours as found in the Degenerative type of the Teamwork structure? The findings imply not only that it is worthwhile avoiding the different degenerative effects caused by high external pressures such as the RAEs in doctoral education in the two subjects, but also that Education departments should see their own role as one which facilitates recognition (and some satisfaction) of doctoral students' needs.

All these issues lead to further and deeper questions concerning the nature of doctoral education. What is the purpose of doctoral education? What is the role played by doctoral education in higher education? Does the current doctoral education cultivate the kind of doctoral students that it intends to? Is doctoral education only concerned with research training? What can the current doctoral education prepare their students for their future? If research is not related to teaching, does doctoral education need to

provide teaching training for doctoral students to prepare them for an academic career in universities? What is the role of research training in doctoral education in the Individualist and Teamwork structures?

This brings to an end my inquiry into the relationship between research and teaching in doctoral education. Such research is not without its problems, as indicated in my critiques of previous studies earlier in the thesis. However, for all the difficulties and uncertainties, this research has been able to shed some light on the relationship between staff research and teaching at doctoral level paying special attention to disciplinary differences. It also highlights the need to further understand the complexity of factors underlying doctoral education. Students' experiences and their suggestions need to be important components of any such research.

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LIST OF APPENDICES

Appendix 1: Questionnaire

Background Information

. Name of current university:_____ • Department:_____

. Home country:

❑ UK ❑ Other European country:_____ ❑ Other country:_____

. Sex: ❑ Male ❑ Female

. Year of study: ❑ 1st ❑ 2nd ❑ 3rd ❑ 4th year or more.

. English is your ❑ Mother tongue. ❑ 2nd language (Official language for government use). ❑ Foreign language.

. In what language did you study in your first degree? ❑ English. ❑ Other_____

. Your main source of funding: ❑ Self-funding (including family and friends support)

❑ Sponsored by others, please state the sponsor_____

. Main reason for doing a PhD: (Please tick the most major one.)

❑ I hope to work in a university. ❑ I hope to get a research job. ❑ It will help my career. ❑ Personal interest. ❑ Put off finding a job. ❑ Other, please state_____

. Contents of study: When I registered,

❑ I had my own clear idea about the topic of my project. ❑ I knew the area where I wanted to do research but not a particular topic. ❑ I had no clear idea of a research topic.

Your Learning Experience of Being a Research Student

.. Physical Learning Environment

. How satisfactory are the facilities and support services provided by your department/university?

• *Please give a rating from 1-7 (1=not satisfied at all;...7=extremely satisfied) on the following:*

( ) a. Library services.

( ) b. Individual working space.

( ) c. Computing facilities.

( ) d. Financial aid for your research work.

( ) e. Availability of formal communication channels, i.e. research student society, complaints and appeal procedures.

. Research Training:

. Does your institution have a research training programme for research students?

❙ Yes. ❑ No. ❑ Don't know. ◄ Please tick only one box.

If yes, how satisfactory is your research training programme?

► Please tick only ***one*** box:

❑ (1): Acceptable quality does not exist in any aspect of the research training programmes.

❑ (2): Acceptable quality exits in *some* of the research training programmes.

❑ (3): Acceptable quality exists in the *majority* of them.

❑ (4): Acceptable quality exists in a substantial majority of them. A few of them are *excellent*.

❑ (5): Acceptable quality exists in *virtually all* of the services. *Some of them are excellent.*

❑ (6): Acceptable quality exists in virtually all of them. At least *half* are excellent.

❑ (7): Acceptable quality exists in all aspects of the services. *Majority of them are excellent.*

.. Departmental Atmosphere

. How are the following aspects of the academic atmosphere in your department?

• *Please give a rating from 1-7 (1=not satisfied at all;...7=extremely satisfied) on the following:*

( ) a. Friendliness of the academic staff.

( ) b. The interaction between staff and research students.

( ) c. The interaction among research students.

( ) d. Social events for research students.

( ) e. Research culture.

. **Academic staff are too busy in their own researches to be available for students.**
) ◄ *Please give a rating from 1-7 (1=strongly disagree;...7=strongly agree)*

. **How well are you made aware of the research projects among the staff in your department?**
) ◄ *Please give a rating from 1-7 (1=not aware at all;...7=extremely aware)*

. **How easily can you share the research facilities/resources with academic staff in your department?**
) ◄ *Please give a rating from 1-7 (1=not easy at all;...7=extremely easy)*

). Supervision

. **How many supervisors do you have at this moment?**
❑ One. ❑ Two. ❑ Three or more.

- Following are two boxes of questions concerning your supervision:
  - **If you have only one supervisor, please fill in the answers in 'Box A', skip the 'Box B' and go directly to question 7.**
  - **If you have two supervisors, please fill in the answers in both 'Box A' and 'Box B' respectively for each of them.**
  - **If you have three or more supervisors, please chose two main supervisors and fill in both boxes respectively for each of them.**

ox A: For Your First Supervisor

. **How active or productive is your supervisor as a researcher?**
( ) ◄ *Please give a rating from 1-7 (1=not active at all;...7=extremely active)* or ❑ Don't know.

. **How well are you made aware of your supervisor's research project(s)?**
( ) ◄ *Please give a rating from 1-7 (1=not aware at all;...7=extremely aware)*

. **Is your supervisor's own research projects close to your thesis topic?**
( ) ◄ *Please give a rating from 1-7 (1=not close at all;...7=extremely close)* or ❑ Don't know.

. **How helpful is your supervisor in finding funding for your study?**
( ) ◄ *Please give a rating from 1-7 (1=not helpful at all;...7=extremely helpful)* or ❑ Don't know.

. **How helpful is your supervisor to your research?**
( ) ◄ *Please give a rating from 1-7 (1=not helpful at all ;...7=extremely helpful)*

. **Do you consider that any aspect of your supervision is hindering your progress?**
- *Please give a rating from 1-7 (1= seriously hindering;...7= not hindering at all) on the following:*

( ) a. Supervisor availability.
( ) b. Lack of helpful guidance/feedback from the supervisor.
( ) c. Supervisor's lack of knowledge (including giving incorrect and distracting information) in my field.
( ) d. Lack of support / encouragement from the supervisor.
( ) e. Supervisor's own research workload is too heavy.
( ) f. Supervisor has too many students.
( ) g. Supervisor is not interested or motivated.
( ) h. Other, please specify_____

ox B: For Your Second Supervisor (if applicable)

. **How active or productive is your supervisor as a researcher?**

( ) ◄ *Please give a rating from 1-7 (1=not active at all;...7=extremely active)* or ❑ Don't know.

. **How well are you made aware of your supervisor's research project(s)?**

( ) ◄ *Please give a rating from 1-7 (1=not aware at all;...7=extremely aware)*

. **Is your supervisor's own research projects close to your thesis topic?**

( ) ◄ *Please give a rating from 1-7 (1=not close at all;...7=extremely close)* or ❑ Don't know.

. **How helpful is your supervisor in finding funding for your study?**

( ) ◄ *Please give a rating from 1-7 (1=not helpful at all;...7=extremely helpful)* or ❑ Don't know.

. **How helpful is your supervisor to your research?**

( ) ◄ *Please give a rating from 1-7 (1=not helpful at all;...7=extremely helpful)*

. **Do you consider that any aspect of your supervision is hindering your progress?**

► *Please give a rating from 1-7 (1= seriously hindering;...7= not hindering at all) on the following:*

( ) a. Supervisor availability.
( ) b. Lack of helpful guidance/feedback from the supervisor.
( ) c. Supervisor's lack of knowledge (including giving incorrect and distracting information) in my field.
( ) d. Lack of support / encouragement from the supervisor.
( ) e. Supervisor's own research workload is too heavy.
( ) f. Supervisor has too many students.
( ) g. Supervisor is not interested or motivated.
( ) h. Other, please specify_____

. From the above questions on supervision:1,2,3,4,5,6a,...6g,6h, please chose three of them which you think are important factors in your PhD study.

► *Please indicate these three in the order of their priorities:* 1st:( ) 2nd:( ) 3rd:( )

. During your PhD study, have you changed your supervisor or stopped seeing one of your supervisors (including change of institution)?

❑ Yes. How many times? _____ ❑ No. ◄ Please tick only one box.

If yes, what caused you to make that decision?

► Please tick ***the most major reason*** for the latest one:

❑ (1): Lack of helpful guidance/feedback from the supervisor.
❑ (2): Supervisor's lack of knowledge (including giving incorrect and distracting information) in my field.
❑ (3): Lack of support / encouragement from the supervisor.
❑ (4): Supervisor's own research workload was too heavy.
❑ (5): Supervisor had too many students.
❑ (6): Supervisor was not interested or motivated.
❑ (7): Other, please specify:_____

. **Inter-Cultural Communication (☛*Please note this part only for overseas and non-UK students*)**

. **Do you consider any aspect of the Inter-Cultural communication is hindering your learning?**

• *Please give a rating from 1-7 (1= seriously hindering;...7= not hindering at all) on the following:*

( ) a. Lack of information and help for overseas students. (e.g. visa application, legal advice.)
( ) b. Lack of interaction among home and international students.
( ) c. Lack of English language assistance.
( ) d. Feelings of differential treatments or discrimination against overseas students.
( ) e. Lack of sympathetic listening and personal support from the department.

Your Perception of the Relationship between Staff Research and Teaching

Vhat is your view on the relationship between staff research and staff supervision?

r **Definition:** "research" here refers to research projects, not for teaching purposes.

▸ *Please read carefully and tick only one box for each statement:*

. **Supervisor shows enthusiasm of his/her own researches in the supervision.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **Staff research, if *not* well managed, will have negative effect on their teaching and supervision.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **A good researcher means a good supervisor.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **Only an active and productive researcher can keep the teaching materials of the highest quality and up-to-date.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **A good supervisor means a good researcher.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **The more research a department produces, the better supervision it provides.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

. **High quality of teaching and supervision should come before staff research as the main priority of the University Education.**

❑ Strongly disagree. ❑ Disagree. ❑ Agree. ❑ Strongly agree. ❑other comments_____

Your comments

.ny comment relevant to either your experience or your opinions on the issue about staff research and :aching will be welcomed: (Please use the reverse side of this paper if there is a need.)

·❖❖

his research might have a follow-up interview. If you are willing to share your experience and your opinions on the :lation between staff research and teaching further, please do not hesitate to contact me or leave your contact details. should be very grateful if you would help again. *Please select the way you prefer to be contacted:*

❑ ***Email:***_____ ❑ ***Phone:***_____

❑ ***Other way:*** _____

Thank you so much for your contribution. I am very grateful for your help. ♥♥♥

Appendix 2: Student Letter

Dear research student,

This is an invitation to take part in a research project that will, I hope, be of value to postgraduate students in universities. This questionnaire concerns your own experiences of being a research student. I would be very grateful if you could share these with me. The questionnaire should take you only 10-15 minutes, and your help will contribute to the quality of educational provision for future fellow students - through providing a better understanding of the interaction between Departments' research performance and the research training they provide. A stamped addressed envelope is enclosed. I would be very grateful if you can complete this questionnaire and return it to me by (the date), 2000 please. Many thanks.

All data collected will be absolutely confidential. The questionnaire is anonymous. Information identifying the respondent or your institution will not be disclosed under any circumstances (including to my supervisor).

This project seeks to investigate the relationship between the indicators of universities' research standing, such as Research Assessment Exercise (RAE) scores, and the training and education experienced by PhD students. I am now studying with Professor Gareth Williams at the London University Institute of Education. This questionnaire is the main part of my PhD programme and will be a study of two subjects, Chemistry and Education. All full-time PhD students in those two subject areas will be randomly selected across the country.

Please visit the following website, which will be available soon, if you are interested in either the findings or the research topic itself:
http://www.ioe.ac.uk/students/Iris_Chiang
If you have any comments relevant to the research or if you would like to share your experience further and personally, please do not hesitate to contact me by email: ckkppsr@ioe.ac.uk

Thank you so much indeed for your co-operation.

With best wishes for your future studies,

Iris Chiang

Appendix 3: Guidelines for the Questionnaire

Before you fill in the questionnaire, please read the Guidelines carefully.

Guidelines of the Questionnaire

► This questionnaire concerns your own experiences of being a research student. You may be asked to evaluate some aspects of the research education you have been through. ***Please rate them according to whether they satisfy your needs for your study as frankly as you can.***

► There are three sections in this questionnaire. The first section is background information about you. The second section concerns your experience of being a research student. The third section concerns your perception of the relationship between staff research and supervision.

► Most questions can simply be answered by putting a tick in the box or by writing in your answer. Some answers may be chosen from a scale from 1-7. If you have any questions about the questionnaire, please email me at: ckkppsr@ioe.ac.uk

I am very grateful for your help.

Thank you very much indeed. ♥

Appendix 4: Interview Questions

Questions for follow-up interviews:
University:_____ Subject:_____
Gender: ❒ Male ❒ Female

A. Way of Interaction in the Group/ Department

A1. Do you feel PhD students are treated as full members of the research community in your department/ group?
❒ Yes. → A1.1 To what extent? For example?
❒ No. → A1.2 For example?
A1.3 Why is that?
A1.4 Rate from 1-10: 10 as full member.
No._____

A2. How often do PhD students have the opportunity for informal interaction with staff in your group/ department?
❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month.
❒ other:
❒ very difficult or almost no informal interaction

A3. How would you describe the general interaction between staff and students in your group/ department?
(from 1-10: 10 as strongest sense)
__ sense of partnership / common purpose (working as a team, working together)
__ sense of distance
__ sense of hierarchy

B. Way of Interaction with Supervisor

B1. Do PhD students and their supervisors in your group/ department work as a team on the same research project?
❒ Yes.
❒ No. → B1.1. How do they work?

B2. How often in general do PhD students in your group meet their supervisors?
❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month.
❒ other:
B2.1. How often do you meet your supervisor?
❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month.
❒ other:

B3. Do you need to make appointment before the meeting?
❒ Yes. ❒ No.
B3.1. Do you think this is typical of other PhD students in your group/ department?
❒ Yes. ❒ No.

B4. To what extent do you think that PhD students in your group/ department regard their supervisors as a working colleague?
(from 1-10: 10 as very much as a working colleague)
No._____ → B4.1. Why?

B5. How often do PhD students have the opportunity for informal interaction with their supervisors in your group/ department?
❒ on a daily basis. ❒ once every week. ❒ once every other week. ❒ once every month.
❒ other:
❒ very difficult or almost no informal interaction

B6. How would you describe the interaction between students in your group/ department and their supervisors or you and your supervisor?
(from 1-10: 10 as strongest sense)
__ sense of partnership / common purpose (working as a team, working together)
__ sense of distance
__ sense of hierarchy

C. Support for Academic Study

C1. Do you think the supervisors in your group/ department are supportive to their PhD students? (academic support)
❒ Yes. → C1.1. How supportive? (from 1-10: 10 as very supportive)
No._____
❒ No. → C1.2. Why?_____
C1.3. How supportive is your supervisor regarding your research? (academic support)
(from 1-10: 10 as very supportive) No._____

C2. How supportive is the department/ group as a whole to PhD students' research?
(technical, administrative, resources)
(from 1-10: 10 very supportive) No. ____
C2.1. For example?

C3. During the process of your PhD study, do you feel isolated?
❒ Yes. → C3.1. How much? (from 1-10: 10 as very isolated)
No._____
❒ No.
C3.2. Do you think this is typical of other students in your group/ department?
❒ Yes.
❒ No.

C4. During the process of your PhD study, do you feel separated / cut off (from other students or the supervisor)?
❒ Yes. → C4.1. How much? (from 1-10: 10 as very separated) No._____
❒ No.
C4.2. Do you think this is typical of other students in your group/ department?
❒ Yes.
❒ No.

C5. During the process of your PhD study, do you feel lonely?
❒ Yes. → C5.1. How much? (from 1-10: 10 as very lonely) No._____
❒ No.
C5.2. Is this typical to other students in your group/ department?
❒ Yes.
❒ No.

C6. During the process of your PhD study, do you feel you have been neglected by the supervisor? (supervisor not interested)
❒ Yes. C6.1. For example?
❒ No.
C6.2. Do you think this is typical to other students in your group/ department?
❒ Yes.
❒ No.

C7. In your doctoral study, do you feel that PhD students' research is neglected by the group/ department as a whole? (not care PhD students, not listen to PhD students' voices)
❒ Yes. C7.1. How?
❒ No.

C8. During the process of your PhD study, do you feel any part of your ideas or efforts or labour have been exploited in a negative way?
❒ Yes. → C8.1. For example?
❒ No.
C8.2. Do you think this is typical to other students in your group/ department?
❒ Yes.
❒ No.

C9. Have you enjoyed your study so far? (student's life and learning experience)
❒ Yes.
❒ No.
C9.1. from 1-10: 10 as very enjoyable. No._____
C9.2. Do you feel other PhD students in your group/ department enjoy their studies?
❒ Yes. ❒ No.
C9.3 Will you recommend your group to future students?
❒ Yes. ❒ No.

Appendix 5:

SPSS Output of T-test of Items in Effectiveness of Supervision and Research Environment for Doctoral Students

A. T-test of Effectiveness of Supervision in Education and Chemistry

Group Statistics

	Subject	N	Mean	Std. Deviation	Std. Error Mean
Overall helpfulness	Education	352	5.38	1.649	.088
	Chemistry	639	5.43	1.628	.064
Student's perception of supervisor's productivity	Education	354	5.32	2.095	.111
	Chemistry	637	4.73	2.224	.088
Awareness of supervisor's projects	Education	353	4.43	1.943	.103
	Chemistry	630	5.31	1.713	.068
Similarity between supervisor and students'	Education	354	3.83	2.154	.114
	Chemistry	621	4.86	2.240	.090
Supervisor's helpfulness in finding funding	Education	277	4.03	2.408	.145
	Chemistry	590	5.91	1.482	.061
Supervisor availability	Education	352	5.61	1.760	.094
	Chemistry	639	5.29	1.811	.072
Supervisor's guidance/ feedback	Education	354	5.38	1.789	.095
	Chemistry	638	5.26	1.783	.071
Supervisor's knowledge	Education	352	5.68	1.706	.091
	Chemistry	637	5.91	1.616	.064
Supervisor's support/ encouragement	Education	353	5.73	1.716	.091
	Chemistry	639	5.62	1.665	.066
Supervisor's research workload	Education	354	5.02	1.940	.103
	Chemistry	635	5.29	1.762	.070
Supervisor's student-load	Education	353	5.39	1.935	.103
	Chemistry	638	5.63	1.709	.068
Supervisor's interest/ motivation	Education	354	6.01	1.673	.089
	Chemistry	638	6.18	1.481	.059

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Overall helpfulness	Equal variance assumed	.119	.730	-.510	989	.610	-.06	.109	-.268	.158
	Equal variance not assumed			-.508	715.537	.612	-.06	.109	-.269	.159
Student's perception c supervisor's productivi	Equal variance assumed	8.018	.005	4.150	989	.000	.60	.144	.316	.883
	Equal variance not assumed			4.222	766.750	.000	.60	.142	.321	.878
Awareness of supervisor's projects	Equal variance assumed	18.646	.000	-7.400	981	.000	-.88	.120	-1.120	-.650
	Equal variance not assumed			-7.143	655.813	.000	-.88	.124	-1.128	-.642
Similarity between supervisor and studen projects	Equal variance assumed	.225	.635	-7.030	973	.000	-1.03	.147	-1.323	-.746
	Equal variance not assumed			-7.105	758.276	.000	-1.03	.146	-1.320	-.748
Supervisor's helpfulne in finding funding	Equal variance assumed	229.121	.000	-14.082	865	.000	-1.88	.133	-2.137	-1.615
	Equal variance not assumed			-11.947	377.233	.000	-1.88	.157	-2.185	-1.567
Supervisor availability	Equal variance assumed	1.269	.260	2.712	989	.007	.32	.119	.089	.556
	Equal variance not assumed			2.735	741.100	.006	.32	.118	.091	.555
Supervisor's guidance feedback	Equal variance assumed	.008	.928	.985	990	.325	.12	.118	-.116	.349
	Equal variance not assumed			.984	726.908	.326	.12	.118	-.116	.349
Supervisor's knowledg	Equal variance assumed	3.081	.080	-2.141	987	.033	-.23	.109	-.449	-.020
	Equal variance not assumed			-2.108	691.852	.035	-.23	.111	-.453	-.016
Supervisor's support/ encouragement	Equal variance assumed	.582	.446	1.049	990	.294	.12	.112	-.102	.336
	Equal variance not assumed			1.040	707.664	.299	.12	.113	-.104	.338
Supervisor's research workload	Equal variance assumed	7.274	.007	-2.290	987	.022	-.28	.121	-.515	-.040
	Equal variance not assumed			-2.228	673.149	.026	-.28	.125	-.522	-.033
Supervisor's student-l	Equal variance assumed	9.894	.002	-2.011	989	.045	-.24	.119	-.473	-.006
	Equal variance not assumed			-1.941	654.100	.053	-.24	.123	-.481	.003
Supervisor's interest/ motivation	Equal variance assumed	5.418	.020	-1.713	990	.087	-.18	.103	-.378	.026
	Equal variance not assumed			-1.654	657.756	.099	-.18	.107	-.385	.033

B. T-test of Effectiveness of Research Environment for Doctoral Students in Education and Chemistry

(English assistance is separately calculated because it excludes those foreign students whose English is their mother tongue.)

Group Statistics

	Subjec	N	Mea	Std.	Std. Mea
Research Programmes	Educatio	322	3.73	1.573	.088
	Chemistr	294	3.47	1.459	.085
Staff approachability	Educatio	354	5.17	1.626	.086
	Chemistr	639	5.47	1.235	.049
Interaction between & students	Educatio	353	4.54	1.729	.092
	Chemistr	637	5.17	1.330	.053
Interaction among students	Educatio	352	4.28	1.633	.087
	Chemistr	639	5.41	1.349	.053
Social events for students	Educatio	349	3.44	1.608	.086
	Chemistr	638	4.46	1.711	.068
Research culture	Educatio	339	4.20	1.737	.094
	Chemistr	621	4.76	1.439	.058
Staff availability	Educatio	352	4.33	1.899	.101
	Chemistr	637	4.80	1.627	.064
Awareness of staff research	Educatio	353	3.60	1.781	.095
	Chemistr	639	4.11	1.575	.062
Facilities shared between staff & students	Educatio	346	3.68	1.830	.098
	Chemistr	631	4.89	1.467	.058
Information for overseas students	Educatio	220	5.00	1.987	.134
	Chemistr	185	5.60	1.662	.122
Interaction with home students	Educatio	222	4.66	1.986	.133
	Chemistr	190	5.39	1.667	.121
Equal treatment	Educatio	220	4.93	2.027	.137
	Chemistr	190	5.72	1.656	.120
Sympathetic listening	Educatio	220	5.05	1.960	.132
	Chemistr	192	5.57	1.680	.121
Library	Educatio	353	5.14	1.460	.078
	Chemistr	639	5.09	1.366	.054
Individual working space	Educatio	351	3.83	2.004	.107
	Chemistr	639	4.92	1.574	.062
Computing facilities	Educatio	351	4.14	1.814	.097
	Chemistr	639	4.80	1.583	.063
Financial support for student's research	Educatio	345	3.53	2.161	.116
	Chemistr	635	5.13	1.487	.059
Communication channel	Educatio	348	4.08	1.698	.091
	Chemistr	613	4.21	1.476	.060

Independent Samples Test

		Levene's Equality of		t-test for Equality of						
									95% Interval of Differen	
		F	Sig	t	df	Sig. (2-	Mea Differen	Std. Differen	Low	Upp
Research Programmes	Equal assum	1.64	.20	2.07	61	.03	.2	.12	.01	.49
	Equal not			2.07	613.84	.03	.2	.12	.01	.49
Staff approachability	Equal assum	33.82	.00	-	99	.00	-	.09	-	-
	Equal not			-	581.83	.00	-	.09	-	-
Interaction between staff & students	Equal assum	47.62	.00	-	98	.00	-	.09	-	-
	Equal not			-	586.07	.00	-	.10	-	-
Interaction among students	Equal assum	27.63	.00	-	98	.00	-	.09	-	-
	Equal not			-	616.57	.00	-	.10	-	-
Social events for student's	Equal assum	2.60	.10	-	98	.00	-	.11	-	-
	Equal not			-	754 36	.00	-	.11	-	-
Research culture	Equal assum	27.36	.00	-	95	.00	-	.10	-	-
	Equal not			-	593.14	00	-	.11	-	-
Staff availability	Equal assum	21.43	.00	-	98	.00	-	.11	-	-
	Equal not			-	635.98	.00	-	.12	-	-
Awareness of staff research	Equal assum	16 63	.00	-	99	.00	-	.11	-	-
	Equal not			-	654.43	.00	-	.11	-	-
Facilities shared between staff & students	Equal assum	53.42	.00	-	97	.00	-	.10	-	-
	Equal not			-	590.94	.00	-	.11	-	-
Information for overseas students	Equal assum	11.41	.00	-	40	.00	-	.18	-	-
	Equal not			-	402.99	.00	-	.18	-	-
Interaction with home students	Equal assum	10.38	.00	-	41	.00	-	.18	-	-
	Equal not			-	409.85	.00	-	.18	-	-
Equal treatment	Equal assum	15.94	.00	-	40	.00	-	.18	-	-
	Equal not			-	406.77	.00	-	.18	-	-
Sympathetic listening	Equal assum	7.09	.00	-	41	.00	-	.18	-	-
	Equal not			-	409.87	.00	-	.17	-	-
Library	Equal assum	4.37	.03	.55	99	.58	.0	.09	-	.23
	Equal not			.54	686.41	.58	.0	.09	-	.23
Individual working space	Equal assum	59 59	.00	-	98	.00	-	11	-	-
	Equal not			-	590.30	.00	-	.12	-	-
Computing facilities	Equal assum	17 26	.00	-	98	.00	-	.11	-	-
	Equal not			-	642.25	.00	-	.11	-	-
Financial support for student's research	Equal assum	158.80	.00	-	97	.00	-	.11	-	-
	Equal not			-	525.06	.00	-	.13	-	-
Communication channel	Equal assum	10.96	.00	-	95	.21	-	.10	-	.07
	Equal not			-	641.49	22	-	.10	-	.08

English assistance:
(excludes those foreign students whose English is their mother tongue)

Group Statistics

	Subject	N	Mean	Std. Deviation	Std. Error Mean
English assistance	Education	209	4.67	2.074	.143
	Chemistry	163	5.44	1.764	.138

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
English assistanc	Equal variance assumed	12.305	.001	-3.792	370	.000	-.77	.203	-1.170	-.371
	Equal variance not assumed			-3.869	367.190	.000	-.77	.199	-1.162	-.379

Appendix 6:
SPSS Output of Principal Component Analysis of Supervision

Communalities

	Initial	Extraction
Overall helpfulness	1.000	.689
Awareness of supervisor's projects	1.000	.691
Similarity between supervisor and students' projects	1.000	.633
Supervisor's helpfulness in finding funding	1.000	.372
Supervisor availability	1.000	.667
Supervisor's guidance/ feedback	1.000	.762
Student's perception of supervisor's productivity	1.000	.603
Supervisor's knowledge	1.000	.683
Supervisor's support/ encouragement	1.000	.688
Supervisor's research workload	1.000	.678
Supervisor's student-load	1.000	.602
Supervisor's interest/ motivation	1.000	.664

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Componen	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.193	43.277	43.277	5.193	43.277	43.277	3.093	25.773	25.773
2	1.503	12.525	55.801	1.503	12.525	55.801	2.503	20.855	46.628
3	1.037	8.643	64.444	1.037	8.643	64.444	2.138	17.816	64.444
4	.955	7.956	72.400						
5	.617	5.138	77.538						
6	.514	4.280	81.818						
7	.468	3.903	85.721						
8	.440	3.663	89.384						
9	.401	3.346	92.730						
10	.349	2.910	95.640						
11	.326	2.719	98.359						
12	.197	1.641	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component		
	1	2	3
Overall helpfulness	.827	5.593E-02	-4.55E-02
Awareness of supervisor's projects	.572	.546	.256
Similarity between supervisor and students' projects	.532	.572	.148
Supervisor's helpfulness in finding funding	.481	.255	-.276
Supervisor availability	.670	-.317	.342
Supervisor's guidance/ feedback	.850	-.155	-.126
Student's perception of supervisor's productivity	.460	.518	.352
Supervisor's knowledge	.694	4.275E-02	-.446
Supervisor's support/ encouragement	.781	-.159	-.229
Supervisor's research workload	.574	-.450	.383
Supervisor's student-load	.575	-.416	.314
Supervisor's interest/ motivation	.729	-.119	-.343

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Rotated Component Matrix[a]

	Component		
	1	2	3
Overall helpfulness	.613	.402	.390
Awareness of supervisor's projects	.212	.132	.793
Similarity between supervisor and students' projects	.261	3.206E-02	.751
Supervisor's helpfulness in finding funding	.531	-4.28E-02	.298
Supervisor availability	.233	.760	.187
Supervisor's guidance/ feedback	.690	.497	.199
Student's perception of supervisor's productivity	6.578E-02	.141	.761
Supervisor's knowledge	.805	.109	.152
Supervisor's support/ encouragement	.715	.404	.122
Supervisor's research workload	.138	.810	5.623E-02
Supervisor's student-load	.188	.751	5.535E-02
Supervisor's interest/ motivation	.758	.286	8.302E-02

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations

Component Transformation Matrix

Component	1	2	3
1	.703	.558	.441
2	-.015	-.608	.794
3	-.711	.565	.420

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Appendix 7:
SPSS Output of Principal Component Analysis of Research Environment for Doctoral Students

Communalities

	Initial	Extraction
Research culture	1.000	.599
Staff availability	1.000	.275
Awareness of staff research	1.000	.325
Facilities shared between staff & students	1.000	.501
Staff approachability	1.000	.578
Interaction between staff & students	1.000	.703
Interaction among students	1.000	.512
Social events for research students	1.000	.507
Library	1.000	.302
Individual working space	1.000	.592
Computing facilities	1.000	.581
Financial support for student's research	1.000	.402
Communication channel	1.000	.463

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.019	38.607	38.607	5.019	38.607	38.607	3.923	30.179	30.179
2	1.321	10.162	48.770	1.321	10.162	48.770	2.417	18.591	48.770
3	.946	7.277	56.047						
4	.902	6.939	62.986						
5	.860	6.616	69.602						
6	.761	5.855	75.457						
7	.669	5.143	80.600						
8	.609	4.683	85.283						
9	.487	3.748	89.031						
10	.451	3.466	92.497						
11	.410	3.155	95.652						
12	.362	2.782	98.434						
13	.204	1.566	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component	
	1	2
Research culture	.758	-.156
Staff availability	.498	-.166
Awareness of staff research	.546	-.165
Facilities shared between staff & students	.707	4.111E-02
Staff approachability	.694	-.310
Interaction between staff & students	.791	-.278
Interaction among students	.659	-.278
Social events for research students	.668	-.246
Library	.346	.426
Individual working space	.547	.541
Computing facilities	.544	.534
Financial support for student's research	.515	.370
Communication channel	.656	.182

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
Research culture	.721	.282
Staff availability	.508	.132
Awareness of staff research	.547	.159
Facilities shared between staff & students	.570	.419
Staff approachability	.751	.118
Interaction between staff & students	.815	.197
Interaction among students	.704	.125
Social events for research students	.694	.157
Library	5.858E-02	.546
Individual working space	.165	.752
Computing facilities	.166	.744
Financial support for student's research	.230	.591
Communication channel	.451	.509

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Component Transformation Matrix

Component	1	2
1	.839	.544
2	-.544	.839

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Appendix 8:
SPSS Output of Principal Component Analysis of Intercultural Facilitation for Research in Research Environment for Doctoral Students

Communalities

	Initial	Extraction
Information for overseas students	1.000	.574
Interaction with home students	1.000	.575
English assistance	1.000	.555
Equal treatment	1.000	.691
Sympathetic listening	1.000	.690

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.085	61.707	61.707	3.085	61.707	61.707
2	.651	13.016	74.723			
3	.544	10.871	85.593			
4	.447	8.942	94.536			
5	.273	5.464	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component
	1
Information for overseas students	.758
Interaction with home students	.758
English assistance	.745
Equal treatment	.831
Sympathetic listening	.831

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Rotated Component Matrix[a]

a. Only one component was extracted. The solution cannot be rotated.

Appendix 9:
SPSS Output of Simple Linear Regression of the Three Components in Supervisory Effectiveness
(by using predictor of RAE scores in Education and Chemistry)

Supervisory effectiveness is composed of three factors: Supervisor's facilitation of learning, Supervisor's accessibility and Relevance of supervisor's research to student's.

A. Supervisor's Facilitation of Learning

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.080[a]	.006	.003	1.08320219

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6.605E-02	.245		.270	.787		
	RAE	-5.66E-02	.043	-.080	-1.316	.189	1.000	1.000

a. Dependent Variable: Supervisor's facilitation of learning

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.001[a]	.000	-.002	.93593344

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.121	.126		.963	.336		
	RAE	-7.29E-04	.025	-.001	-.030	.976	1.000	1.000

a. Dependent Variable: Supervisor's facilitation of learning

B. Supervisor's Accessibility

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.019[a]	.000	-.003	1.05171485

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.233	.237		.982	.327		
	RAE	-1.31E-02	.042	-.019	-.313	.754	1.000	1.000

a. Dependent Variable: Supervisor's accessibility

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.079[a]	.006	.005	.96418276

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.155	.129		1.194	.233		
	RAE	-4.78E-02	.025	-.079	-1.890	.059	1.000	1.000

a. Dependent Variable: Supervisor's accessibility

C. Relevance of Supervisor's Research to Student's

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.040[a]	.002	-.002	.97070283

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.281	.219		-1.282	.201		
	RAE	2.550E-02	.039	.040	.661	.509	1.000	1.000

a. Dependent Variable: Relevance of supervisor's research to student's

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.068[a]	.005	.003	1.00658349

a. Predictors: (Constant), RAE

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.141	.135		-1.043	.298		
	RAE	4.297E-02	.026	.068	1.628	.104	1.000	1.000

a. Dependent Variable: Relevance of supervisor's research to student's

Appendix 10:

SPSS Output of Simple Linear Regression of the Four Components in Effective Research Environment for Doctoral Students
(by using predictor of RAE scores in Education and Chemistry)

Research environment for doctoral students mainly concerns four aspects: Academic culture of social interaction, Intercultural facilitation of research, Research training programmes and Research facilities.

A. Academic Culture of Social Interaction

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.019[a]	.000	-.003	1.06166802

a. Predictors: (Constant), RAE

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant	-.258	.232		-1.112	.267
	RAE	-1.39E-	.041	-.019	-.342	.732

a. Dependent Variable: Academic culture of social interaction

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.139[a]	.019	.018	.91006077

a. Predictors: (Constant), RAE

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant)	.574	.122		4.705	.000
	RAE	-8.03E-	.024	-.139	-3.401	.001

a. Dependent Variable: Academic culture of social interaction

B. Intercultural Facilitation of Research

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.078[a]	.006	.001	1.02591030

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.139	.319		.435	.664
	RAE	-6.18E-02	.054	-.078	-1.143	.254

a. Dependent Variable: Intercultural facilitation of research

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.040[a]	.002	-.004	.90655893

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.143	.221		.649	.517
	RAE	2.296E-02	.042	.040	.541	.589

a. Dependent Variable: Intercultural facilitation of research

C. Research Training Programmes

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.006[a]	.000	-.003	1.575

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.688	.355		10.397	.000
	RAE	6.910E-03	.061	.006	.113	.910

a. Dependent Variable: Research Training Programme

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.186[a]	.034	.031	1.436

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.690	.257		10.483	.000
	RAE	.174	.054	.186	3.226	.001

a. Dependent Variable: Research Training Programme

D. Research Facilities

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.187[a]	.035	.032	1.06596460

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.436	.233		1.876	.062
	RAE	-.138	.041	-.187	-3.380	.001

a. Dependent Variable: Research facilities

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.248[a]	.062	.060	.87916076

a. Predictors: (Constant), RAE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.523	.118		-4.438	.000
	RAE	.142	.023	.248	6.209	.000

a. Dependent Variable: Research facilities

Appendix 11:
SPSS Output of Multiple Linear Regression of Supervisory Effectiveness
(by using predictors of RAE, subject and other variables)

Three major aspects of supervision are examined: Supervisor's facilitation of learning, Supervisor's accessibility and Relevance of supervisor's research to student's.

A. Supervisor's Facilitation of Learning

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.294[a]	.087	.081	.95860187

a. Predictors: (Constant), Gender, Asian students, Year of study, RAE, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.494	.131		3.754	.000		
	RAE	-4.18E-03	.021	-.007	-.198	.843	.956	1.046
	Subject	-.221	.076	-.103	-2.891	.004	.855	1.169
	Year of study	-.156	.031	-.168	-5.017	.000	.973	1.028
	Asian students	-.492	.102	-.167	-4.833	.000	.914	1.094
	Gender	5.969E-02	.068	.030	.881	.379	.956	1.046

a. Dependent Variable: Supervisor's facilitation of learning

2001RAE:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.297[a]	.088	.082	.96046701

a. Predictors: (Constant), Gender, Asian students, 2001RAE, Year of study, Subject

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.583	.207		2.810	.005
	2001RAE	-1.94E-02	.032	-.021	-.600	.548
	Subject	-.242	.078	-.114	-3.105	.002
	Year of study	-.151	.032	-.163	-4.759	.000
	Asian students	-.496	.101	-.171	-4.889	.000
	Gender	6.607E-02	.069	.033	.954	.340

a. Dependent Variable: Supervisor's facilitation of learning

B. Supervisor's Accessibility

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.208[a]	.043	.038	.98104996

a. Predictors: (Constant), Gender, Year of study, RAE, English as foreign language, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.345	.135		2.551	.011		
	RAE	3.26E-02	.021	-.052	-1.517	.130	.966	1.035
	Subject	.347	.078	.163	4.459	.000	.861	1.161
	Year of study	-.105	.032	-.114	-3.319	.001	.974	1.027
	English as foreign languag	-.275	.077	-.125	-3.570	.000	.936	1.069
	Gender	070E-02	.069	.035	1.019	.308	.955	1.047

a. Dependent Variable: Supervisor's accessibility

2001RAE:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.219[a]	.048	.042	.98155928

a. Predictors: (Constant), Gender, Year of study, 2001RAE, English as foreign language, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.641	.212		3.022	.003
	2001RAE	-7.69E-02	.033	-.082	-2.327	.020
	Subject	.282	.079	.133	3.555	.000
	Year of study	-.104	.032	-.112	-3.215	.001
	English as foreign language	-.284	.078	-.129	-3.619	.000
	Gender	8.688E-02	.071	.043	1.227	.220

a. Dependent Variable: Supervisor's accessibility

C. Relevance of Supervisor's Research to Student's

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.164[a]	.027	.020	.98997020

a. Predictors: (Constant), Year of study, Gender, RAE, English as mother tongue, Subject, Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	4.037E-03	.151		.027	.979		
	RAE	3.866E-02	.022	.062	1.771	.077	.953	1.049
	Subject	-.170	.081	-.080	-2.107	.035	.813	1.229
	Gender	-.238	.070	-.119	-3.398	.001	.956	1.046
	English as mother tongue	-1.38E-02	.081	-.007	-.170	.865	.744	1.344
	Asian students	-6.53E-02	.115	-.022	-.569	.569	.766	1.305
	Year of study	-6.24E-03	.032	-.007	-.195	.846	.973	1.028

a. Dependent Variable: Relevance of supervisor's research to student's

2001RAE:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.163[a]	.026	.019	.98284529

a. Predictors: (Constant), Year of study, 2001RAE, Gender, English as mother tongue, Subject, Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.282	.223		1.261	.208
	2001RAE	-9.03E-03	.033	-.010	-.273	.785
	Subject	-.187	.082	-.089	-2.274	.023
	Gender	-.234	.071	-.118	-3.295	.001
	English as mother tongue	-4.30E-02	.082	-.021	-.522	.602
	Asian students	-7.22E-02	.114	-.025	-.633	.527
	Year of study	-2.22E-03	.032	-.002	-.068	.945

a. Dependent Variable: Relevance of supervisor's research to student's

Appendix 12:
SPSS Output of Multiple Linear Regression of Effective Research Environment for Doctoral Students
(by using predictors of RAE, subject and other variables)

Four major aspects of research environment for doctoral students are examined: Academic culture of social interaction, Intercultural facilitation of research, Research training programme and Research facilities.

A. Academic Culture of Social Interaction

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.330[a]	.109	.103	.94710056

a. Predictors: (Constant), Gender, Year of study, English as mother tongue, RAE, Subject, Asian students

Coefficients [a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity	
		B	Std.	Beta			Toleranc	VIF
1	(Constant)	.646	.140		4.604	.000		
	RAE	-4.61E-	.020	-.073	-2 250	.025	.955	1.047
	Subject	-.316	.074	-.150	-4.287	.000	.805	1.242
	Year of study	-.134	.030	-.144	-4 523	000	.975	1.026
	English as mother tongue	.159	.076	.078	2.101	036	.725	1.380
	Asian students	-.250	.103	-.087	-2 418	.016	773	1 294
	Gender	-.106	064	- 053	-1.642	.101	.959	1 042

a. Dependent Variable: Academic culture of social interaction

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.227[a]	.052	.036	1.04076389

a. Predictors: (Constant), Gender, Asian students, Year of study, RAE, English as mother tongue

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant)	7.280E-	.288		.253	.800
	RAE	1.572E-	.042	.022	.378	.706
	Year of study	-.132	.053	-.138	-2.491	.013
	English as mother tongue	.119	.137	.054	.869	.386
	Asian students	-.302	.148	-.125	-2.039	.042
	Gender	-.203	.121	-.094	-1.675	.095

a. Dependent Variable: Academic culture of social interaction

Education (2001RAE)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.226[a]	.051	.036	1.04094604

a. Predictors: (Constant), Gender, Asian students, Year of study, 2001RAE, English as mother tongue

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant)	9.047E-	.412		.220	.826
	2001RAE	1.272E-	.068	.010	.186	.853
	Year of study	-.132	.053	-.138	-2.496	.013
	English as mother tongue	.111	.135	.050	.821	.412
	Asian students	-.298	.147	-.123	-2.020	.044
	Gender	-.200	.121	-.092	-1.652	.099

a. Dependent Variable: Academic culture of social interaction

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.250[a]	.063	.055	.89275620

a. Predictors: (Constant), Gender, English as mother tongue, RAE, Year of study, Asian students

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant)	.705	.159		4.427	.000
	RAE	-7.37E-	.023	-.127	-3.170	.002
	Year of study	-.129	.036	-.146	-3.616	.000
	English as mother tongue	.218	.091	.106	2.389	.017
	Asian students	-.199	.155	-.057	-1.283	.200
	Gender	-5.99E-	.075	-.032	-.795	.427

a. Dependent Variable: Academic culture of social interaction

Chemistry (2001RAE):

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.261[a]	.068	.060	.87929594

a. Predictors: (Constant), Gender, English as mother tongue, 2001RAE, Year of study, Asian students

Coefficients[a]

Mode		Unstandardized Coefficient		Standardized Coefficient	t	Sig.
		B	Std.	Beta		
1	(Constant)	1.117	.227		4.928	.000
	2001RAE	-.129	.034	-.159	-3.849	.000
	Year of study	-.116	.036	-.133	-3.214	.001
	English as mother tongue	.171	.093	.084	1.841	.066
	Asian students	-.268	.154	-.080	-1.738	.083
	Gender	-2.03E-	.076	-.011	-.265	.791

a. Dependent Variable: Academic culture of social interaction

B. Intercultural Facilitation of Research

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.354[a]	.125	.112	.94237277

a. Predictors: (Constant), Gender, Asian students, Year of study, English as mother tongue, RAE, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.469	.196		2.389	.017		
	RAE	.942E-04	.033	.000	.006	.995	.905	1.105
	Subject	-.336	.101	-.167	-3.315	.001	.868	1.152
	English as mother tongu	.430	.170	.121	2.532	.012	.963	1.038
	Asian students	-.450	.102	-.213	-4.398	.000	.946	1.057
	Year of study	-6.25E-02	.043	-.070	-1.459	.145	.968	1.033
	Gender	-5.25E-02	.096	-.026	-.550	.583	.968	1.033

a. Dependent Variable: Intercultural facilitation of research

2001RAE:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.357[a]	.128	.114	.94819424

a. Predictors: (Constant), Gender, Asian students, 2001RAE, Year of study, English as mother tongue, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.311	.321		.969	.333
	2001RAE	3.099E-02	.052	.030	.601	.548
	Subject	-.330	.103	-.163	-3.190	.002
	English as mother tongue	.426	.174	.119	2.451	.015
	Asian students	-.454	.103	-.214	-4.413	.000
	Year of study	-7.14E-02	.043	-.080	-1.647	.100
	Gender	-4.34E-02	.098	-.022	-.445	.657

a. Dependent Variable: Intercultural facilitation of research

C. Research Training Programmes

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.214[a]	.046	.038	1.494

a. Predictors: (Constant), Gender, Far East Asian students, Year of study, RAE, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	3.469	.248		13.991	.000		
	RAE	9.845E-02	.041	.103	2.412	.016	.860	1.163
	Subject	.344	.136	.113	2.527	.012	.785	1.274
	Year of study	-.147	.057	-.105	-2.593	.010	.949	1.053
	Far East Asian students	-.504	.180	-.115	-2.804	.005	.933	1.071
	Gender	-.243	.124	-.080	-1.959	.051	.941	1.062

a. Dependent Variable: Research Training Programme

Education

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.225[a]	.050	.038	1.542

a. Predictors: (Constant), Gender, Far East Asian students, Year of study

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.333	.433		10.004	.000
	RAE	2.334E-02	.062	.021	.379	.705
	Year of study	-.186	.079	-.131	-2.351	.019
	Far East Asian students	-.621	.213	-.162	-2.913	.004
	Gender	-.197	.178	-.061	-1.111	.267

a. Dependent Variable: Research Training Programme

Education (2001RAE)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.238[a]	.057	.045	1.537

a. Predictors: (Constant), Gender, 2001RAE, Far East Asian students, Year of study

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.576	.652		5.488	.000
	2001RAE	.157	.106	.082	1.474	.142
	Year of study	-.175	.079	-.123	-2.223	.027
	Far East Asian students	-.639	.210	-.167	-3.041	.003
	Gender	-.199	.177	-.062	-1.124	.262

a. Dependent Variable: Research Training Programme

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.218[a]	.047	.034	1.433

a. Predictors: (Constant), Gender, Year of study, RAE, Far East Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.045	.325		9.375	.000
	RAE	.168	.054	.180	3.122	.002
	Year of study	-.111	.081	-.079	-1.374	.171
	Far East Asian students	4.322E-02	.360	.007	.120	.905
	Gender	-.239	.173	-.080	-1.381	.168

a. Dependent Variable: Research Training Programme

Chemistry (2001RAE)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.192[a]	.037	.022	1.464

a. Predictors: (Constant), Gender, 2001RAE, Year of study, Far East Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.797	.503		5.559	.000
	2001RAE	.194	.080	.146	2.425	.016
	Year of study	-.127	.086	-.089	-1.479	.140
	Far East Asian students	3.443E-02	.369	.006	.093	.926
	Gender	-.237	.184	-.078	-1.289	.198

a. Dependent Variable: Research Training Programme

D. Research Facilities

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.274[a]	.075	.070	.96425934

a. Predictors: (Constant), Gender, Year of study, RAE, Far East Asian students, Subject

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-4.68E-02	.129		-.364	.716		
	RAE	6.057E-02	.021	.095	2.910	.004	.960	1.042
	Subject	-.460	.072	-.219	-6.399	.000	.875	1.143
	Far East Asian students	-.344	.106	-.108	-3.261	.001	.930	1.075
	Year of study	-1.63E-02	.030	-.018	-.540	.590	.973	1.028
	Gender	-5.62E-02	.066	-.028	-.858	.391	.960	1.042

a. Dependent Variable: Research facilities

Education:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.258[a]	.066	.054	1.05355453

a. Predictors: (Constant), Gender, Year of study, RAE, Far East Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.535	.275		1.949	.052
	RAE	-.115	.041	-.156	-2.792	.006
	Far East Asian students	-.448	.147	-.170	-3.041	.003
	Year of study	-4.43E-02	.054	-.045	-.825	.410
	Gender	-2.72E-02	.122	-.012	-.222	.824

a. Dependent Variable: Research facilities

Education (2001RAE)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.279[a]	.078	.066	1.04715150

a. Predictors: (Constant), Gender, Year of study, 2001RAE, Far East Asian students

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.196	.407		2.939	.004
	2001RAE	-.236	.069	-.188	-3.422	.001
	Far East Asian students	-.463	.145	-.176	-3.190	.002
	Year of study	-4.33E-02	.053	-.044	-.811	.418
	Gender	-3.39E-02	.121	-.015	-.280	.780

a. Dependent Variable: Research facilities

Chemistry

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.249[a]	.062	.056	.88112878

a. Predictors: (Constant), Gender, RAE, Far East Asian students, Year of study

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.478	.141		-3.386	.001
	RAE	.142	.023	.249	6.206	.000
	Far East Asian students	2.648E-02	.159	.007	.167	.868
	Year of study	-1.79E-02	.035	-.020	-.508	.612
	Gender	-2.51E-02	.074	-.014	-.338	.735

a. Dependent Variable: Research facilities

Chemistry (2001RAE)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.226[a]	.051	.044	.88439459

a. Predictors: (Constant), Gender, 2001RAE, Far East Asian students, Year of study

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.841	.215		-3.908	.000
	2001RAE	.184	.034	.226	5.436	.000
	Far East Asian students	4.102E-02	.160	.011	.256	.798
	Year of study	-1.45E-02	.036	-.017	-.399	.690
	Gender	-3.85E-02	.077	-.021	-.501	.616

a. Dependent Variable: Research facilities

Appendix 13:

Two Examples from the Interview Data

Two examples of the clustered data are presented here. One is the section of "Relevance of supervisor's research to student's" under the category of Supervision. The second is the section responding to the question of whether doctoral students are treated as full member of research community in "Institutional facilitation of research" under Research environment for doctoral students. In each section, interviews of four Education students are presented first.

A. Relevance of Supervisor's Research to Student's

'A' in an Education department with high RAE score

A does not work on the same research project as his supervisor. "He has his own research which is not the same as mine. He doesn't look at higher education. He doesn't look at the process of socialisation and profession. In that way, his work is very different from my work, although he helps me with mine." A does not know about how other students' projects relate to their supervisors'.

'B' in an Education department with high RAE score

In this Education department, supervisors and their students do not work on the same research project. Apart from a very small numbers of students working on funded research projects, the majority of students and their supervisors work on different ones. For the knowledge of supervisors' research, "Some [students] found them [their supervisors' projects] out by looking for their recent list of publications, or searching the web. Somehow they put their research on posters on display in the department two years ago." B does not know whether the department have up-dated the information. In most cases, students are not aware of what their supervisors' current projects are.

'C' in an Education department with low RAE score

PhD students and their supervisors in the department usually do not work as a team on the same research project. They have shared area of academic interests, but in most cases, their research projects are not related. In the case of C, she was working with the supervisor on the same funded research.

'D' in an Education department with low RAE score

PhD students and their supervisors in the department do not work on the same research project. "They share common interest, but they are working on different areas."

'F' in a Chemistry department with high RAE score

Almost all of students and their supervisors both in the group and department work as a team on the same research project. "That is the commonality of the subject."

'G' in a Chemistry department with high RAE score

PhD students and their supervisors in the department work as a team on the same research project. "You have to. That is the definition of a research group. The research group will fall apart if there wasn't a team. Without a team, this type of

structure just wouldn't work." Working as a team provides important support for students. "If there wasn't a team, I just don't see how it works. It would be a very difficult relationship."

'H' in a Chemistry department with low RAE score

PhD students and their supervisors in the department work as a team on the same research project: "Yes, very much so." and "really ninety-nine percent of them." Supervisors apply for the funding and recruit students to help with this research project. They are working as a team. It is almost impossible to find a single student who works on his/her own. "Because generally the supervisor applies for funding to do a certain project. It is a very strict guideline on what that money then can be used for. At the end of the studentship, three years or four years, the supervisor has to turn around to the funding council and say 'what is and what I have discovered'. If he hasn't done what he said he was going to do, then that was very bad. It must be bad for future grant applications." "Almost a hundred percent of students work on what their supervisors tell them to work on. That's not to say they can't be creative and try things out and move around bit and confine the project, but the goal is the same."

'J' in a Chemistry department with low RAE score

All PhD students work as a team with their supervisors on the same research project. Even though, some supervisors hardly do the experiments or visit the laboratory.

B. Institutional Facilitation of Research

'A' in an Education department with high RAE score

A does not think PhD students are treated as full members of the research community in the department. "Not really, no." One of the contributing factors is that A does not have many contacts with the department apart from the seminars. "I don't really hang around in the department. I normally just go to see my supervisor once every two weeks. So I don't really go that much to the department." "I don't really spend that much time in the department." The only contact that A has with the department is the seminars. "That's the only time I really interact with the department. I don't really hang out there for much of the time." In those seminars, the discrepancy in the treatments between staff and students to some extent are detected. "The time that I do get such is the seminar stuff. I would say we are kind of treated the same. But obviously they have greater knowledge and experience so you can tell the difference between the staff members and PhD students." For example, "One will be age and also, you know, confidence in asking questions or answering questions. And just, you know, all that level of the knowledge and the quality of the questions asked." It is mainly caused by the "power imbalance" between the two. "I guess we are treated as equal. But underlying that, there is a power imbalance based on the amount of knowledge." "On the surface, we are treated the same. You can ask questions and someone else you can interject as anyone else. But then I think apparently more with the lecturers because they know more about the field. Although on the surface we are treated the same, even we know that we are not the same. They know, we know."

'B' in an Education department with high RAE score

B thinks PhD students in this Education department are not treated as full members of the research community. The sense of partnership or common purpose (working as a team or working together) between students and staff is very low.

'C' in an Education department with low RAE score

C feels she is treated as a full member of the research community. It is "most commonly by default". For example, C is invited to all faculty and staff meetings although she is not a student representative. She is also consulted by staff on issues about students' opinions. She has direct approach to faculty facilities and information. She has easy access to staff. She is able to talk to people whenever she need to when it is convenient for them. It is seen that the recognition as a full member of the community is to do with students' age and experience. Due to C's age and experience, "I have always been treated as a member of staff. I had a lot of respect and forms to use the facilities". On the other hand, it is not so lucky for other students, particularly young ones who have not with such experience. The majority of students are not so much treated as full member of the community. In general, it was rated as 5-6 from the scale of 1-10 (10 as full member). Most students "wouldn't necessarily be able to make a direct approach." They might have to make appointment, have to wait, have to write a letter or have to ask their supervisors to write a letter on their behalf in order to have the access to staff, faculty facilities and resources that they need in their research. They need to negotiate in the department before using these resources. For example, "some of the youngest students have even found it is difficult to be able to negotiate coming and working in the office at unusual hours." Those students are asked for a letter from supervisors every time when they want to work in the office outside lecture hours.

'D' in an Education department with low RAE score

PhD students do not feel they are treated as full members of the research community in the department. "No, I don't. Although I think the department is making some efforts, no, I think there is a divide." There is a gulf between the ways that staff and students are treated. One of the reasons is that staff are seen to stick with their own community which is more permanent and familiar for them. "I believe it is to do with the fact that the tutors, the research tutors, and people who are teaching and members of the staff, as opposed to research students, they already have a community in which they interact. They meet each other on the level of being a member of staff. And therefore, they have a different or maybe more permanent network, whereas PhD students are there, you know, maybe for three or four years. They come and go slightly in that three or four years, whereas staff, they will meet their colleagues who maybe research colleagues, they meet those colleagues on a much more regular basis because they probably teach with them. They share appointments within the department, so they may be responsible for students and graduate students. So they meet much more often, I think. And therefore, I think, they see each other as being *staff*. And then you have this strange business of where research students fit in. That's how I think it is different."

The strong and exclusive nature of the staff network makes it difficult for research students to be part of the community. "The students don't share the sort of their ideas. If there is any arrangements about the money has been paid or the way that systems are treated in the department, they are always outside of those considerations whereas staff, I think, that draws them together. I think that's a very clear distinction." "It's the way of uniting you together, isn't it? Whereas I don't believe that research students have that, you are not part of that, those other elements of being part of the community. You might be part of the community in terms of the research students.

But you don't share those other trials and tribulations of being employed by that department, by that university. I think they are very important mechanism before creating either an inclusive or even a divided community, but nevertheless you are part of the particular set up. And I think research students are not part of that."

One of the things that manifest the discrepancy between the staff community and research students is the way the two relate on a daily basis. For example, "You didn't necessarily bump into other members of the research group at the free times. You have to make the appointments to go and see either your own supervisor. You are never *part* of that department. You never got involved in sort of more ... I mean, it doesn't mean to say you won't be asked to come in or you couldn't be in the department, but I'm always a bit of an outsider."

The strong network of staff makes students feel excluded. "You are not one of them yet. You are smarting to be one of them if you like. You are felt you still have the word 'student' in your title if you like. You are a research student almost regardless of how old you are. I am fifty so I was a research student when I was 48, 49. To some extent, I was older than some of the people who were part of the research community. But I was still learning." "They [staff] already have a fairly strong network and research students are not part of that established network and will go away eventually anyway." Because M has done some teaching in the department, the sense of being treated as full members of the community is lower for students who not even teach in the department.

'F' in a Chemistry department with high RAE score

About being treated as a full member of the community, the students' experiences differ at different levels. At least two levels can be identified: the group and the department. In F's group, there are about 10 active members including the supervisor, postdocs, one Master student, final year project students and 5 PhD students. F feels he is treated as a full member of the community in the group. It was rated as 7/8 out of 10 (10 as a full member). There is mutual respect between students and their supervisor. The supervisor is very open to students' ideas. The interaction between the two is active. They discuss things on the equal basis. Students' opinions on the research project are valued. F feels gradually treated like as a postdoc, who is regarded as a full member of the staff. "I am treated as a PhD student. But as part of the training, I'm slowly allowed a degree of independence towards the one that a postdoc might have." On the other hand, the supervisor is not good at motivating students who are not so interested in the project.

There is not much interaction between students among different groups. This could be because students in each group are highly regarded themselves and are not keen to interact with students in other groups. "The main reason is how students regard their own sub-discipline or particular area of project: certain students feel contempt for what we are doing and also there's a sort of internal 'ranking' of supervisors: therefore students working for 'top' supervisors are more conceited and do not have much contact with other students."

'G' in a Chemistry department with high RAE score

Regarding the issue of treatment, initially students, especially those at their first year, are not treated as full members of the community. It is rated as 5/6 out of 10 (10 as

treated as a full member). This could be because first year students do not have the experience or expertise in the field. Students who are more senior are more likely to be treated as full members of the community. It is rated as 8 out of 10. "By the second and third year, they [students] have got more background information and they are basically the experts in the field in the department." Another reason could be because of the network with the staff. For example, "I came in as an international student. I didn't do the undergraduate here. So it took a while to get to know the network of people."

The relationship among graduate students is very close and supportive in a group. It is described as "frankly helpful and ebullience". "I will try to do the best as much as I can to help each other to succeed. There is not a lot of competition among graduate students." "They are willing to put down their stuff to help each other out. That is what I have seen so far."

'H' in a Chemistry department with low RAE score

PhD students in this department are treated as full members of the research community. It is rated as 7 out of 10 (10 as full member). There are two reasons. The first one is due to a large number of PhD students. Compared to 5 or 6 postdocs in the department, the numbers of PhD students, more than 25 of them, is quite sizeable. "Because of the numbers, I think, they [PhD students] are better treated - as quite well as the members of staff." The considerable number of PhD students is resulted from the poor finance in the department. PhD students are regarded as "better value for money" than hiring ordinary staff such as postdoc or research fellow. "The department is quite poor financially. I think demands of postdocs' research work is demands of students'. It is heavily downloaded to the students. So there may be 5 or 6 postdocs in the whole department, but there are more like 25 PhD students. I think it would be even more than that actually, because they [research students] are better value for money." The second reason of being treated as full members of the community is that PhD students are very valued by the department. The department research carried out by each group heavily depends on PhD students. It is not only the large number of PhD students but also "The way that people really reply on their PhD students. There are *many many* groups they don't have any postdocs so PhD students are really the labour in the group to all the work. So they are very important as such that they are really integrated."

'J' in a Chemistry department with low RAE score

In general PhD students are treated as full members of the research community in the department. It is rated as 8 out of 10 (10 as full member). Students' opinions are very much valued especially in the group. It is this sense of value for students that made J feel treated as a full member of the group. For example, "If there is an academic problem, question of research or whatever, it is quite obvious that in our group especially, not so much departmental, we used to have regular group meetings anyway, everybody is encouraged to speak their minds."

Appendix 14:

Table 2-4:Multiple-realities in PhD Study at the Individual Level

"*": highlighted as especially for foreign students.

	Important factors for PhD study	Problems and difficulties
1. Supervisor-student relationship concerned	• *Authenticity* (McBride & Skau, 1995) Trust (McBride & Skau, 1995) • *Apprenticeship* (Burgess et al., 1992 in Burgess et al., 1995: 139) • *Balance* between collaboration and independence (Pole et al., 1997: 590) • *Ethics* of supervision (Stacy, 1999: 88-89) Supervisor responsibilities (Becher et al., 1994: 111-113) in humanities (CVCP, 1986 in Burgess et al., 1995: 147) Different methods of supervision (Welsh, 1979: 45) • *Equality of the relationship* (Pole et al., 1997: 56) • *Effective supervision*: "Personal warmth with professional guidance" (Welsh, 1979: 48; Wright & Lodwick, 1989 and more in Hockey, 1991: 328; Brown & Atkins, 1988: 122; Channell, 1990: 74) • *Supportive environment* and share in a personal relationship with the student (Wilson, 1980; Zuber-Skerritt, 1986; Wright & Lodwick, 1989: 50 all in Hockey, 1991: 328) • *Debate of supervisor and thesis committee* (Becher et al., 1994: 114) • *Good relationship* with supervisor (Burgess et al., 1995: 142; Ballard & Clanchy, 1984 in Johnston, 1999: 25) • *Good match* between supervisors and students (Elton & Pope, 1989; Maor & Fraser, 1995: 6)	• *Abuse* in negligent supervision: using research students as unacknowledged assistants (Brown & Atkins, 1988: 117) Apprenticeship turns into exploitation (Nelson, 1995; esp. in science, Becher et al., 1994: 148; in science "dogsbodies" Clark, 1993: 139) • *Problems in the relationship* with supervisor (Katz & Hartnett, 1976; Lozoff, 1976; Taylor, 1976; Schon, 1987 all in Hockey, 1991: 327; Connell, 1985: 38 in Pearson, 1999: 276) Imbalance of power (Becher et al., 1994: 148) Personality clash (Wisker, 1996: 142-143) Disappointment of supervision (Becher et al., 1994: 144) * Unclear expectations from supervisors (Geake & Maingard, 1999: 55) • *Problems in apprenticeship* arginalisation and individual apprenticeship (Becher et al., 1994: 148) • *Lack of a sense of being valued* as an individual person (Becher et al., 1994: 144) • *Problems with the ideas of autonomy* and the independent scholar that underpin the traditional practices of postgraduate pedagogy (Johnson et al., 2000: 137) • * *The "human" qualities* of the supervisor e.g. Someone who is in the know is available and someone to talk to; some staff are uncaring and uninterested (Aspland & O'Donoghue, 1994:66-69) • * *Cultural stereotype* of academic ability (Channell, 1990: 75)
2. Knowledge concerned	• *Issue of ownership* (Maor & Fraser, 1995: 7, 11; Pole et al., 1997: 51) • *Choice of topic* (van Hout, 1991: 1; Maor & Fraser, 1995: 10-11; Pole et al., 1997: 51) Ensure a promising topic which should produce sufficient results within time limits (Wisker, 1996: 140, 142) • *The applied nature of research* (Maor & Fraser, 1995: 11) • *Importance of fieldwork* (Delamont et al., 2000: 72-93) • *Help students* define the research task (Becher et al., 1994: 98)	• *Debate of originality and training* echer et al., 1994: 108) • *Difficulties in changing direction or design or methods* (Brown & Atkins, 1989 in Hockey, 1991:325) • *Deficiency of skill in data collection or analysis* (Delamont & Eggleston, 1983 in Hockey, 1991: 325; ABRC, 1982 in Burgess et al., 1995: 140) • *Choosing topic which is feasible to finish in 4 years* (Rudd, 1985: 64-68; ABRC, 1982 in Burgess et al., 1995: 140; Hout, 1991: 1)

	Assist students to develop standards of achievement, a thesis of merit (Wisker, 1996: 140) Assist students to state the research problem and review of relevant theory and research (Schön, 1987: 13 in Pearson & Brew, 2002: 140; Wisker, 1996: 143; Pole et al., 1997: 53) Teaching strategies of research (Wisker, 1996: 143) • *Supervisor's knowledge* in general subject of the research, in the conduct of the research and in the equipment required for experiment (Pole et al., 1997: 54) • *Ensure success of research programme is operationally sound* (Becher et al., 1994: 100) • * *Sensitivity* to different approaches to knowledge (Todd, 1997: 178-179) • *Supervisor development* (Pearson & Brew, 2002: 143-148)	• *Dissatisfaction of supervision* (Rudd, 1975: 73-77; Welsh, 1979: 27; Young et al., 1987: 23; Walford, 1981 all in Hockey, 1991: 326; Maor & Fraser, 1995: 7) Poor supervision (Wright & Lodwick, 1989: 25; Delamont & Eggleston, 1983; Moses, 84 all in Hockey, 1991: 326; ABRC, 1982 in Burgess et al., 1995: 140) Quality of supervision process (Brown & Atkins, 1988: 117-118 in Hockey, 1991: 327; Blume, 1995: 19; Heath, 2002: 50) • *Supervisors' limited expertise* in students' research area (Geake & Maingard, 1999: 55; Heath, 2002: 50) • * *Pedagogical alienation* (Aspland, 1999: 37-38)
3. Communication/ Access concerned	• *Adequacy of supervision* (SERC, 1982; Swinnerton-Dyer, 1982; CVCP, 1985; Winfield, 1987 all in Hockey, 1991: 326; Becher et al., 1994: 97-98) Regularity of supervision (Wisker, 1996: 142; UK Council of Graduate Education, 1996: 26) • *Reflective problem solving* (McBride & Skau, 1995) • *Mentoring* (Pearson, 1996: 315; Moses, 1994:9 in Zuber-Skerritt & Ryan, 1994; Maor & Fraser, 1995: 7; Jacobi, 1991 in Leder, 1995: 6; Lyons et al., 1990 in McMichael, 1993; Pearson & Brew, 2002: 140-141) Pastoral dimension (Hockey, 1995) • *Monitoring of feedback* from supervisors (UK Council of Graduate Education, 1996: 27) • *Monitoring of students' processes* (UK Council of Graduate Education, 1996: 27; Maor & Fraser, 1995: 8-9) • *Clear guidance* needed in the middle of confusion and uncertainty (Pole et al., 1997: 52) • *Guidance concerning the planning, organising and time-scaling* of the PhD process. (Delamont & Eggleston, 1981, 83; Porter et al., 1982; ESRC, 1986; Wright & Lodwick, 1989 all in Hockey, 1991:326; Becher et al., 1994: 122-125; Maor & Fraser, 1995: 11; May, 1997: 59-75) • * *Sensitivity* to the needs of overseas students (CVCP/CDP, 1992:4)	• *Debate on the traditional one-to-one apprenticeship model* (Yeatman, 1995; Conrad, Perry & Zuber-Skerritt, 1992; Knight & Zuber-Skerritt, 1992 all in Johnston, 1999: 23; Clark, 1995: 81-83) Apprenticeship and constraint of student's work (Leder, 1995: 5) • *Supervisors' workload* (Holdaway, 1997: 68) • *Supervisors' student-load* (Maor & Fraser, 1995: 10) • *Problem of supervisor availability* (Becher et al., 1994: 144-145; Channell, 1990: 70-73 in Kinnell, 1990; Heath, 2002: 50) Availability and access to supervisor (Pole et al., 1997: 60-61) Frequency of supervision (Robbins, 1963; Rudd, 1975: 74-77; Winfield, 1987: 68; Wright & Lodwick, 1989: 55 all in Hockey, 1991: 327; Maor & Fraser, 1995: 12; Geake & Maingard, 1999: 59; Heath, 2002: 50-51) • * *Unclear on the way to confront the inadequacies of the supervision* (Becher et al., 1994: 145) • *Communication breakdown* with supervisor (Phillips, 1994: 134-141; Graves, 1997: 88-90) • * *Difficulties in making friends* (Church, 1982 in Makepeace, 1989:21; Makepeace, 1989: 35-36; Sandeman-Gay, 1999: 45) • * *Difficulties in verbal and non-verbal*

	Cultural sensitivity to different education background (CVCP/CDP, 1992: 4; Geake & Maingard, 1999: 55) Awareness of cultural differences in education training (Todd, 1997: 176-178; Cryer & Okorocha, 1999: 111; Channell, 1990: 74) Supervisor's cultural understanding (Aspland & O'Donoghue, 1994:71-72) • * *Attitudes towards other cultures* (Channell, 1990: 73-76)	*communication* (Church, 1982 in Makepeace, 1989:21; Cryer & Okorocha, 1999: 113-115) • * *Discussing problems* in taking part in seminars (Makepeace, 1989: 29-30; Ballard & Clanchy, 1984 in Johnston, 1999: 25) • * *Isolation* (Knight, 1999: 99)
4. Empower-ment concerned	• *Empowerment of PhD students* (McBride & Skau, 1995) • *Publication of students' work* (Maor & Fraser, 1995: 9; Becher et al., 1994: 118-120; Heath, 2002: 51) • *Self development* of students (Hockey, 1991:322) • *Collaboration in team work* in science subjects (Maor & Fraser, 1995: 9-10; Pole et al., 1997: 50-51, 58-59) • *Financial support* for conferences and present papers (Maor & Fraser, 1995: 2) Links with industry and outside organisations in scientific subjects (Maor & Fraser, 1995: 11) • *Supervisor's passion* for students' works (Pole et al., 1997: 54) • *Personal support, encouragement, motivation* (Maor & Fraser, 1995: 4; Pole et al., 1997: 54; Heath, 2002: 52) • *Development of students' confidence* (Pole et al., 1997: 55; Hockey, 1995: 204) • *Development of students' autonomy* (Pole et al., 1997: 57) • *Help students establish professional contacts* (Becher et al., 1994: 120-122; Maor & Fraser, 1995: 11) • * *Encourage to promote the integration* of overseas and home students (CVCP/CDP, 1992: 4)	• *Lost of confidence* (Becher et al., 1994: 146) • *Feelings of confusion and disorientation at early stage* (Maor & Fraser, 1995: 5; Pole et al., 1997: 52) Uncertainty (Pole et al., 1997: 52, 53) • *Attrition / Diminish enthusiasm* (Phillips, 1980 in Hockey, 1991; 325; Noble, 1994: 26; Clark, 1993: 141) Boredom (Wilkinson, 1989: 48; Phillips & Pugh, 1987: 68 both in Hockey, 1991: 325) Loneliness (Rudd, 1975: 86-106; Burgess et al., 1992 both in Burgess et al., 1995: 141; Welsh, 1979: 36-37; Clark, 1993: 137-138) esp in humanities and social sciences (Clark, 1995: 83) Low motivation (ABRC, 1982 in Burgess et al., 1995: 140; Clark, 1993: 138-139) • *Difficulties in writing up stage* (Hout, 1991:1) Delay and incoherence (Wason, 1974 in Hockey, 1991: 325; Phillips & Pugh, 1987: 59-60 in Hockey, 1991: 325) Slowness in formulating what to write (Rudd, 1985:71 in Hockey, 1991: 325) Difficulty in bringing material into coherent shape (Rudd, 1985: 71 in Hockey, 1991:325) Writing problems and productivity (Becher et al., 1994: 109-113) • *Time planing* (Hout, 1991:1) • * *Language proficiency* in writing, speaking, professional jargon (Church, 1982 in Makepeace, 1989:21) Difficulties in understanding colloquial language, accents (Makepeace, 1989: 27-28)

Appendix 15:

Table 2-7: Multiple-realities in PhD Study at the Aggregate Level

"*": highlighted as especially for foreign students.

	Important factors for PhD study	Problems and difficulties
1. Institutional structure	• *Institutional structure*: to cope with greater numbers of students (Pearson, 1999: 274) • *Institutional programme*: student induction, support, study skills and writing support. (Pearson, 1999: 274; Maor & Fraser, 1995: 5-6) **Importance of orientation programmes* for overseas students. (Unterhalter & Green, 1997) • *Supervisor training* (Moses, 1994: 8) • *Effective arrangement* for the selection of examiners. (UK Council for Graduate Education, 1996: 28) • * *Clear procedure and full consultation* for course or institutional transfers for foreign students. (CVCP/ CDP, 1992: 5) • *Information on job market opportunities* (Nerad & Cerny, 1991 in Pearson, 1999:280; Moses, 1994:9) Labour market consideration. (Blume, 1995:29; Burgess et al., 1995: 143, 150-153) Students' expectations in different disciplines. (Becher et al., 1994: 166-173; Burgess, 1997: 12-13) Extra provisions for career development for students. (Pearson, 1996: 314) • *Accountability of student fees* eg. extra charge of £1,700 of each overseas student (Greenaway & Tuck, 1995: 24)	• *Departmental problems* in coping with growing numbers of students (Blume, 1995: 21) • *Vulnerability* of research students (esp. in science): no place to complain about supervision (Becher et al., 1994: 148) • *Marginality* (Hockey, 1991:322; Becher et al., 1994: 147, 148; Holdaway, 1997) eg housing arrangements, common rooms, food services opportunities for social and recreational activities (Clark, 1995: 83) Administrative decentralisation (Bowen & Rudenstine, 1992 in Pearson, 1996: 303) "Virtual systems" (Becher et al., 1994: 147) • *Low submission rate* (Noble, 1994: 29; Dunkerly & Weeks, 1994: 149-166; ABRC, 82 in Burgess et al., 1995: 140) Esp. in social sciences (Rothschild, 1982; ABRC, 1982; Winfield, 1987 all in Burgess et al., 1995: 144; Holdaway, 1997: 71-72) • *Non-completion* (Becher et al., 1994: 157-158; Clark, 1993: 141-143) Due to no securing employment for PhD qualification (Becher at al, 1994: 157) • *Dropout and Failure:* (Becher et al., 1994: 153-155) Misconstrued the nature of research work or not sufficiently committed; inadequately advised; no one was aware they were in trouble (Becher et al., 1994: 153; Clark, 1993: 141-143) • * *Adjustment problems*: (Church, 1982 in Makepeace, 1989:21) eg. Food, climate, new norms and values (Sen, 1970: 78-104; Church, 1982 in Makepeace, 1989:21) **Culture shock* (Makepeace, 1989: 21, 23-24; Furnham, 1997: 14-17) * *Homesickness* (Church, 1982 in Makepeace, 1989:21; Makepeace, 1989: 22-23; Furnham, 1997: 17-18) * *Ignorance* of host nationals about home culture (Church, 1982 in Makepeace, 1989:21) • * *Information concerning welfare* eg. Immigration laws, financial support, religious life

		(Makepeace, 1989: 37) * *Immigration difficulties* (Church, 1982 in Makepeace, 1989:21) • *Employment issues* (Nelson, 1995; Noble, 1994: 27; Bulmer, McKennell & Schonhardt-Bailey, 1994) * Employment opportunities back home (Church, 1982 in Makepeace, 1989:21)
2. Research training	• *Research training culture* (Deem & Brehony, 2000: 156-158) • *Disciplinary differences* in training needs. (Becher et al., 1994: 103-106) • *Provision of academic and vocational courses* (Burgess, 1998) Structure of the programme (Nerad & Cerny, 1991 in Pearson, 1999:280) • *Internationalisation* (Blume, 1995: 15, 32-35) • *Experience of teaching* (Becher et al., 1994: 116-118) Development of teaching skills (Holdaway, 1997: 71; UK Council for Graduate Education, 1996: 26)	• *Debate of education and training* (Burgess, 1998; Collinson, 1998:59; Blume, 1986; Blume, 1995: 18; Becher et al., 1994: 101-103; Burgess, 1997: 8-10) • *Lack of programmatic structure* eg. Absence of curricular structure (Clark, 1995: 83) •* *Adjustment* to new educational system (Church, 1982 in Makepeace, 1989:21) * Adjustment and academic performance (Mohamed, 1997: 156-172) • *Disappointment about seminars:* eg. critical culture (not constructive feedback) of the graduate seminar (Becher et al., 1994: 151) • *Lack of support* from the department for research students' teaching (Becher et al., 1994: 148)
3. Research environment	• **Information of facilities* for foreign students before registration: Comprehensive and accurate information on access to labs, equipment and library facilities prior to the start of the course. (CVCP/CDP, 1992:5) • *Access to facilities* (Phillips, 1993 in Pearson, 1999: 277) • *Adequate resources and support* for students (Haworth & Conrad, 1997 in Pearson, 1999: 279; Nerad & Cerny, 1991 in Pearson, 1999:280; Blume, 1995: 22) *Particularly specialist facilities* (UK Council for Graduate Education, 1996: 25) *Provision of office facilities* including word processor facilities (UK Council for Graduate Education, 1996: 25) *General resources*, eg library (Phillips, 1993 in Pearson, 1999: 277; Becher et al., 1994: 122-125; UK Council for Graduate Education, 1996: 25) • *Financial resources* (Phillips, 1993 in Pearson, 1999: 277) Type of financial support and research money (Nerad & Cerny, 1991 in Pearson, 1999:280; Moses, 1994:9) Resources for student awards (Becher, Henkel & Kogan, 1994: 27-28) Funding for infrastructure and funding for	• *Dissatisfactory resources* (Becher et al., 1994: 123-125; Phillips & Pugh, 1987) Dissatisfactions with library and computers (Welsh, 1979: 39-40) Dissatisfactions with working space eg. noisy and crowded (Clark, 1993: 140) Limited working and social facilities (Becher et al., 1994: 126-127) • *Financial problem* (Becher et al., 1994: 127-128, 158-160; Welsh, 1979: 37-38) Perception that funds attracted for postgraduates are not spent on them (Ibrahim et al., 1980 in Leder, 95) * *Financial problems for overseas students* (Allen & Higgins, 1994: 65; Church, 1982 in Makepeace, 1989:21) * Overseas students live and work under greater financial pressure (Veile, 1988:3) • *Accommodation* (Becher et al., 1994: 147; Welsh, 1979: 38-39)

	student support (Holdaway, 1997: 66-67) Funding including facilities for travel and conference attendance (UK Council for Graduate Education, 1996:25; Maor & Fraser, 1995: 2) * Itemised bench fees in sciences (CVCP/CDP, 1992: 3) * In no circumstances should a student be charged supplementary fees later in the course. (CVCP/CDP, 1992: 3) • *Technical assistance* (Pearson, 1996: 306)	
4. Research culture	(Laske & Zuber-Skerritt, 1996 in Pearson, 1999: 278; Sheehan, 1994; UK Council for Graduate Education, 1996: 25) ***a. Research concerned*** • *Coherence and integration of its research* (Blume, 1995: 22; de Wied et al., 1991 in Holdaway, 1997: 66) • *Critical mass of research* in order to create the conditions for excellent graduate work (Bowen & Rudenstine, 1992: 70 in Holdaway, 1997: 66; Harris Report, 1996: 56) • *Pedagogic continuity* (Delamont, Atkinson & Parry, 1997:323; Delamont et al., 2000: 152-172) ***b. Access concerned*** • *An open* research environment: all students have access (Pearson, 1999: 282) • *Experience in mixing* with other academics, giving papers and becoming part of a culture as a colleague. (Pearson, 1996: 306) • *Student access to professional opportunities* (Pearson, 1996: 315) Encourage students to present in the seminars (UK Council for Graduate Education, 1996: 27) Importance of including postdocs (or other experienced and more or less full-time researchers) (Blume, 1995: 22) Strategies for accessing a peer network of other student/researchers (Pearson, 1996: 306) *Induction to academic life for foreign students (Macrae, 1997: 127-142) • *Arrangements for the representation of doctoral students views and incorporation of their interests in policy-making* (UK Council for Graduate Education, 1996: 25) ***c. Atmosphere concerned*** • *Status of PhD students*	***a. Research concerned*** • *Intellectual isolation*: lack of formal and informal interaction with staff (Welsh, 1979: 35-36; Blume, 1995: 22; Becher et al., 1994: 147) Collegiality or academic isolation (Hockey, 1991:324) Student isolation (Bowen & Rudenstine, 1992 in Pearson, 1996: 303; Becher et al., 1994: 142-144; Phillips & Pugh, 1987) • *Disappointment about seminars* echer et al., 1994: 151) ***b. Access concerned*** • **Difficulties in accessing research culture*, academic culture and peer culture (Deem & Brehony, 2000: 149) • *Scientific research groups are isolated* from each other: cut off from students' contemporaries even if it is interdisciplinary (Becher et al., 1994; 149) • * *Problems of integration*: Overseas students live and work in greater isolation. (Veile, 1988:3) Cultural difference and prejudice (Veile, 1988:3) ***c. Atmosphere concerned*** • *Marginality* Sense of neglect

	(Pearson, 1996: 303) • *Value of collegiality* (Elton, 1989; Hockey, 1991:324; Pearson, 1996: 314) • *Departmental climate* (Nerad & Cerny, 1991 in Pearson, 1999:280) A vibrant research environment (Moses, 1994: 9) A participatory culture (Haworth & Conrad, 1997 in Pearson, 1999: 279) A sense of a community of learners (Haworth & Conrad, 1997 in Pearson, 1999: 279) A risk-taking environment (Haworth & Conrad, 1997 in Pearson, 1999: 279) ***d. Interaction concerned*** • *Research student culture* (Deem & Brehony, 2000: 153-156) Co-operative peer learning (Haworth & Conrad, 1997 in Pearson, 1999: 279) Peer group (Phillips, 1993 in Pearson, 1999: 277; UK Council for Graduate Education, 1996: 25) Opportunities for interaction with peers (Blume, 1995: 22; de Wied et al., 1991 in Holdaway, 1997: 66) *Social support and friendship network for foreign students (Furnham, 1997: 18-20) • *Academic culture* Classification, identity, professions and socialisation (Delamont et al., 2000: 1-17) Academic research culture eg. disciplinary ideas, knowledge production, cultural practices and narratives, departmental sociability, intellectual networks (Deem & Brehony, 2000: 158-162) *Out-of-class activities* (Haworth & Conrad, 1997 in Pearson, 1999: 279) *Opportunities for formal and informal interaction with senior scholars* (Blume, 1995:22; de Wied et al., 1991 in Holdaway, 1997: 66) *Staff support* (Phillips, 1993 in Pearson, 1999: 277) **Sensitivity to possible misunderstanding in verbal and non-verbal communication* (Veile, 1988:3) **Sensitivity to learning in different cultures* (Cortazzi & Jin, 1997: 76-90; Althen, 1994)	(Becher et al., 1994: 154) • * *Marginalisation of foreign students:* * Not been valued (Veile, 1988: 3) * Only valued for money (Veile, 1988:3) • *Lack of clear identity*: neither student nor staff echer et al., 1994; 147) * Unclear identity of foreign students eg. Client, guest or visitor? hurch, 1982 in Makepeace, 1989:21) • * *Exploitation of overseas students* (Walls, 1999) ***d. Interaction concerned*** • *Social isolation* (Hockey, 1991: 324; Blume, 1995: 22; Becher et al., 1994: 147) • Academic culture: Unsatisfactory experience and academic culture. Problems in prestigious institutions -criticism of Humboldtian ideal of research (Becher et al., 1994: 150) *Lack of intellectual interchange* between students and students and staff (Becher et al., 1994: 150 • *Adjustment for 1st PhD students*: eg. Change of social, physical conditions and new teaching and learning (Welsh, 1979: 32-34) The transition from undergraduate to postgraduate status (Hockey, 1991:322) • **Stereotype of classification to consider overseas students as clients with special needs.* This leads to patronisation or even racism. (Makepeace, 1989:6) • **Racial discrimination* (Church, 1982 in Makepeace, 1989:21; Makepeace, 1989:24-25; Sen, 1970: 80-81)